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VOLUME



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T H E
PRACTICAL NAVIGATOR,
A N D

Seaman's New Daily Assistant;

Being a complete System of

PRACTICAL NAVIGATION,

Improved and rendered easy to the meanest Capacity.

Wherein is shewn

How to allow for Variation, Lee-way, Heave of the Sea, Setting of Currents, and to correct the Dead Reckoning, by an Observation in all Cases, not only for a single Day, but many.

The whole exemplified in a

J O U R N A L

Kept from London to Madeira, and back again to England.

To which is added,

The Substance of a young Officer's Examination respecting the Management of a Ship, including the Methods of mooring, unmooring, and working her in all difficult Cases at Sea, or coming into Harbour, with proper Directions for sailing up and down the Channel.

Method of surveying Sea Coasts, Harbours, and measuring accessible and inaccessible Heights and Distances.

The new Method of finding the Longitude by the Moon's Distance from the Sun, or a fixed Star.

The new Method of finding the Latitude by two Altitudes of the Sun; with the Tables of Natural Sines, new Solar Tables, and correct Tables of Difference of Latitude and Departure to 300 Miles Distance, Logarithms, and all other Tables useful in Navigation.

The whole constructed upon a new and methodical Plan.

By **JOHN HAMILTON MOORE,**
Teacher of the Mathematics, and late of the Royal Navy.

The **THIRD EDITION,** CORRECTED and ENLARGED.

L O N D O N,

Printed for B. LAW, Avemary Lane; G. ROBINSON, Paternoster Row;
and RICHARDSON and URQUHART, Royal Exchange. 1776.

TO THE HONOURABLE

AUGUSTUS KEPPEL,
VICE-ADMIRAL OF THE BLUE.

S I R,

THE great Importance of Navigation, and the Encouragement given for determining the Longitude at Sea, have engaged the Attention of Mankind for many Years: Though Artists have not arrived at the Summit of their Wishes, yet, their Inventions, Observations, and Improvements, have brought Navigation to a Degree of Perfection unknown to former Ages.

An Attempt to comprise in a small Compass the Effentials of every useful Discovery and Improvement hitherto made, and to render them easy and practical, will, I hope, merit your Approbation.

The favourable Reception my former Attempts have met with, encouraged me to publish this new and much improved Edition of my Work, under the Patronage of a Commander so well ac-

quainted

quainted with every Part of Nautical Knowledge, and who has so signally distinguished himself in the Defence of his Country; while his beneficent, and generous Disposition, render him dear to every Seaman.

That you may long continue to be an Ornament and a Defence to this Nation, is a Hope sincerely entertained by

Your most obedient

and humble Servant,

JOHN HAMILTON MOORE.

P R E F A C E.

I SHALL not amuse the Reader with any pompous Eulogium on the Merits of this Performance, or endeavour, as is customary, to anticipate the public Favour by a recital of Excellencies, which in the Opinion of some may be of a disputable Nature : Thus much I may venture to say, that the adding one to the Number of Treatises already extant will not appear superfluous, when we consider the Importance of the Subject, and the many recent Discoveries and Improvements made in this valuable Art, which render many of the former Treatises in a Manner obsolete. It must therefore be judged absolutely necessary to instruct the industrious Mariner in those interesting Particulars so conducive to his Advantage. On this Principle the following Publication makes its Appearance, containing in a small Compass the Essentials of every Thing hitherto composed upon the Subject, laid down in such a Manner as to render it not only a complete Companion for Seamen, but also a short and comprehensive Method for those whose Province it is to instruct others ;

others; for want of such, Teachers have been often obliged to take Part from one Book, and Part from another.

It must be allowed that many Books already published upon Navigation have their particular Merits; but some of them are so voluminous, that they either bewilder, or are beyond the Capacity of the greater Number of Learners, and most of them unfit for general Use at Sea. Others, on the contrary, are so concise, especially in the practical Part, as to deprive them of that Knowledge which is absolutely requisite in keeping a Ship's Way. My Care therefore has been to avoid an unnecessary Prolixity, and an abstruse Brevity; and to lead the Pupil gradually on, without Embarrassment or Perplexity. How far it will answer the End intended, will in some Measure be obvious to any judicious Mariner, by taking a short View of the Plan pursued.

In the geometrical Parts are only given those Problems which are absolutely necessary in the Art, in the most familiar Manner.

Trigonometry, being the Foundation of Plane and Mercator's Sailing, is treated of at sufficient Length; in which is shewn how to lay down the several Lines upon the Plane Scale, and its Use, with that of Gunter's Scale and the Logarithms.—The Axioms are here rendered very plain; and though they are generally received as known Truths, yet their Demonstrations are set down at the Bottom of the Page by way of Notes; and all the Cases in Right-angled Trigonometry worked by making each Side Radius and Gunter's Scale.

As an Introduction to Navigation, it was thought proper to give a short Description of the Solar System, wherein the Earth is considered as a Planet moving round the Sun, the real and imaginary Lines on which are particularly defined.

Then follows Plane Sailing, wherein the Earth is supposed an extended Plane, and the several Cases are worked by Geometry, Trigonometry, Gunter's Scale, and Inspection, that the Learner may be able to prove his Work several Ways; and for his Exercise therein, are added six Questions, and two in Traverse Sailing. Plane Sailing being founded upon the false Notion of the Earth's being a Plane, is therefore insufficient for ascertaining the Ship's true Place; hence arises the Necessity of working by Middle Latitude, or Mercator's Sailing, they being founded upon the true Notion of the Earth's being a Sphere or Globe; by which means the Ship's Place is determined with Ease and Accuracy; in which is comprised the Construction and Use of Mercator's Chart.

The Application of Oblique-angled Trigonometry to the Solution of the several Cases of Oblique and Current Sailing, is treated in as concise and intelligent a Manner as possible.

The Application of what has been already treated of, to the grand Purpose of keeping a Ship's Reckoning, comes next to be explained; preparatory to which it was thought proper to begin with a short Dissertation upon Winds and Tides, and to find the Time of the Moon's Age, and Time of High Water, which is here done by a Method more accurate than is generally to be met with.

The

The Use of Hadley's Quadrant comes next, and how to find the Latitude by the meridian Altitude of the Sun or Star, and the Variation of the Compass by an Amplitude, Azimuth, and equal Altitudes of the Sun, rendered plain to any common Capacity; and then a Description of the Log and Log-line, and how to correct the Distance given by them when faulty.

The Pupil is next led into the Rules for keeping a Journal at Sea; wherein are exhibited the Method of allowing for Variation, Lee-way, Heave of the Sea, Setting of the Current, &c. and to correct the Dead Reckoning by an Observation in all Cases, not only for the Ship's Run in one Day, but many; and being duly attended to, may be the Means of preventing the fatal Accidents which so frequently befall those Seamen who depend so much upon their own Self-sufficiency. For it must be allowed, that any Observation or Correction made to help the Judgment, must be preferable to a Guess, which but too many of them depend upon, though the Lives and Fortunes of so many are committed to their Charge.

It was thought proper first to shew how to work several Day's Work independent of each other, and then a regular Journal from London to Madeira, and back again to England; wherein are exemplified the foregoing Rules for Variation, Lying-to, Lee-way, &c. with most of the Occurrences that commonly happen at Sea, or in Harbour, and the Ship's Way pricked off on Mercator's Chart.

The keeping a Sea Journal being fully treated of, as being necessary for rendering the young Navigator expert, which a Number of dry Problems could never do,

is then given the Substance of that Examination which every Candidate for a Commission, either in the Navy or East India Service, must necessarily pass through, previous to his Appointment, respecting the Management of a Ship, from her first coming out of Dock to her clearing the Land; containing the Methods of mooring, unmooring, and working a Ship in all difficult Cases, either in a Storm, on a Lee-shore, or going in or out of Harbour. These Instructions being duly attended to, when at Sea, will be the Means of improving a Youth more in one Voyage than he otherwise would in two. To these are added Directions for sailing up the English Channel, shewing the Dangers, and the best Marks to avoid them.

The next Thing judged necessary is the surveying of Sea Coasts and Harbours, either by sailing along them, or by Observations made on Shore; and how to measure accessible and inaccessible Heights and Distances, which are here laid down in a plain Manner, with an Explanation of the Sea Terms.

The foregoing Articles being well understood, might be thought sufficient to complete the Navigator; but since there have been lately found Methods of ascertaining the Ship's Place by celestial Observation, when the meridian Altitude of the Sun or Star cannot be obtained; it therefore behoves every Seaman to make himself acquainted with so useful a Discovery.

The first is the finding the Latitude, by taking two Altitudes of the Sun when near the Meridian; in performing

a

which,

which, Care has been here taken to omit nothing that might facilitate the Operations in this useful Problem.

The Latitude being found, there is only wanted the true Longitude for determining the Ship's Place: For notwithstanding the Rules for finding the Longitude by having the true Latitude are the most rational that could be given; yet, as they in some Measure depend upon the Ship's Run, they must consequently be liable to Errors; and therefore the Mariner may well be desirous of some other Method that might be depended upon with more Certainty.

The ascertaining the Longitude by celestial Observation so long desired, and now by the Accuracy of Mayer's Lunar Tables, the Excellence of Hadley's Quadrant, and the Industry of Mr. Maskelyne and others is rendered practical, and without any great Trouble, may be considered as one of the greatest Improvements Navigation has ever received.

The Rules here laid down for performing this important Operation are the most simple that could be given, and are illustrated by a sufficient Number of Examples, to which are added the New Solar Tables, and Tables of Natural Sines.

As correct Tables, which this Book abounds with more than any other of the Kind, are of the greatest Importance; besides the Care taken in correcting the Press, they

they have been further examined and compared with several different Copies of the same Kind, by which Means many Errors in the Tables of Difference of Latitude and Departure have been corrected with such Care, that they may be depended on, and the other Tables are as correct as any extant.

In the Execution of this Work Care has been taken to keep in View not only the Mariner at Sea, but also the Teacher in his School; and the best nautical Writers as well as the Observations and Remarks of several able Mariners have been consulted. The several Parts of this Work have been handled more or less fully according to their apparent practical Importance; and it is hoped nothing is omitted that is material either to Teacher or actual Practitioner.

Long and tedious Demonstrations have been carefully avoided, as being of little Use in the Practice of Navigation, and inconsistent with the Plan; but those who are curious may find them in Robertson, and some other Books which abound with them.

Notwithstanding the favourable Reception my first Attempt met with from the Public, I have been induced to revise the whole, and to comprize in the Descriptive Part more than double the Quantity contained in the first Edition, and make such other Alterations, Amendments and Additions as render this almost an entire new Work.

Having thus given some Account of the Plan which is intended to facilitate the Improvement of Youth in nautical Knowledge, and be an useful Companion for Seamen; how far I have succeeded in the Attempt is left to the candid Judgment of the Public to determine.

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T H E

PRACTICAL NAVIGATOR,

A N D

SEAMAN'S NEW DAILY ASSISTANT.

G E O M E T R Y.

D E F I N I T I O N S.

GEOMETRY is that Science by which we compare such Quantities together as have Extension, i. e. Lines, Superficies, and Solids, whose Original is from a Point.

I.

A Point hath no Parts ; that is, a Geometrical Point is not any Quantity, but only an assignable Place in any A . Quantity denoted by a Point, as at A.

‘ Such a Place may be conceived so infinitely small, as to be void of Length, Breadth, and Thickness ; and therefore a Point may be said to have no Parts.’

II.

A Right Line is the nearest Distance between two Points, which limit its Length, as A B. A————B

III.

Circular Lines are those which lie bending between Two Points.

IV.

Parallel Lines are those that are equally distant in all their Parts, which being infinitely extended, will never meet.



A

V.

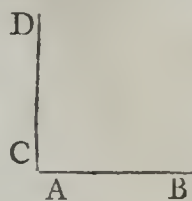
V.

Lines not parallel, but inclining towards each other, whether they are right Lines or circular, will, if they are extended, meet, and make an Angle; the Point where they meet is called the Angular Point, as at A; and, according as such Lines stand nearer or farther off each other, the Angle is said to be greater or less, whether the Lines that include the Angle be long or short.

All Angles included between Right Lines, are called Right-lined Angles, and fall under these three Denominations; viz. A Right Angle, an Obtuse Angle, and an Acute Angle.

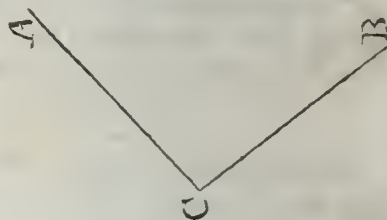
VI.

A Right Angle is that which is included between two Lines that meet each other perpendicularly, as DC meets AB.



VII.

An Obtuse Angle is that which is greater than a Right Angle, such as the Angle included between the Lines AC and CB.



VIII.

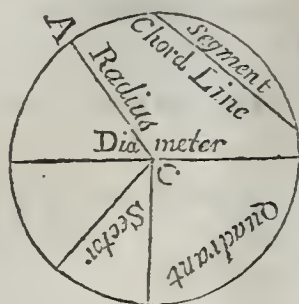
An Acute Angle is that which is less than a Right Angle, such as the Angle included between the Lines CB and CD; these Angles are called Oblique Angles.



IX.

A Circle is a perfect round Figure; the Point C, in the Middle, is the Centre, and is bounded by a round Line, called its Circumference, or Periphery.

A Right Line, drawn from the Centre to the Circumference, is called the *Radius*; or it is the Distance taken in the Compasses to describe a Circle, as AC.



NOTE.

‘ **NOTE.** The Radius, generally used in describing Circles, is
 ‘ 60° (taken from the Line of Chords); the Circumference of
 ‘ which will contain 360° , the number of equal Parts or Degrees
 ‘ that all Circles are supposed to be divided into; and each of these
 ‘ Degrees are divided into 60 equal Parts, called Minutes, &c.

‘ All Angles are measured by an Arch of this Circle, described
 ‘ upon the Angular Point as a Centre, with the Chord of 60° , as
 ‘ above, and the Angle is said to be greater or less, according to the
 ‘ Number of Degrees contained between the Legs; but the Sides
 ‘ or Legs are measured by a Scale of equal Parts.

The *Diameter* is twice its Radius, joined into one Right Line drawn through the Centre, which divides the Circle into two equal Parts called Semi-circles.

A *Quadrant* is Half a Semi-circle.

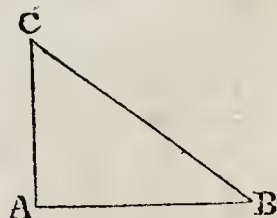
A *Chord Line* is a Right Line that cuts the Circle into two unequal Parts called Segments.

A *Sector* is a Figure included between two Radius's, and is less than a Quadrant.

All Plain Triangles are Figures comprehended under three Right Lines, and are distinguished into three Sorts; viz. A Right-angled Triangle, an Obtuse-angled Triangle, and an Acute-angled Triangle.

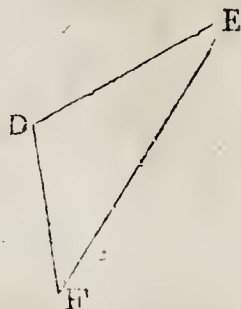
X.

A Right-angled Triangle is that which hath one of its Legs perpendicular to the other, and is equal to a Quadrant or 90° , as B A C; the longest side of which is called the Hypotenuse, as B C, and the other two Sides are called Legs.



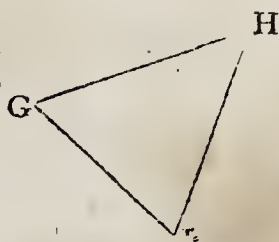
XI.

An Obtuse-angled Triangle is that which hath one of its Angles greater than a Right Angle, as D E F.



XII.

An Acute-angled Triangle is that which hath all its Angles less than a Right Angle, as G H I.



XIII.

The Three Angles of every Triangle are equal to a Semi-circle, or 180° : the two Acute Angles of every Right-angled Triangle are equal to 90° .

XIV.

Sides or Angles given, are marked with a Dash; but, when required, with a Cypher.

XV.

Degrees are always marked with a Cypher over them, and Minutes, with a Dash.

XVI.

Three Letters denote an Angle; the Middle one shews the Angular Point, and the other two the Sides that inclose it.

XVII.

$\begin{matrix} d \\ m \end{matrix} \}$ after any Number signifies $\begin{matrix} \text{Degrees} \\ \text{Minutes} \end{matrix} \}$ thus $\begin{matrix} 25\ d \\ 25\ m \end{matrix}$
 $25\ d$ is 25 Degrees, and $25\ m$ is 25 Minutes.

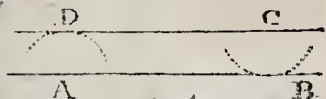
$\angle$	stands for	An Angle
+		More
$\times$		Multiplication
$=$		Equal to
$\div$		Division
$-$		Less
Δ		Triangle
S.		Sine
S. C.		Sine Complement or Co-Sine
T.		Tangent
T. C.		Tangent Complement or Co-Tangent
Sec.		Secant
Sec. C.		Secant Complement or Co-Secant
Co. Ar.		Complement Arithmetic
...	is to, or to the	
...	so is, as thus, $2 \dots 4 :: 3 \dots 6$.	
...	That is, as 2 is to 4, so is 3 to 6.	

GEOMETRICAL PROBLEMS.

P R O B L E M I.

To draw a Line parallel to a given Line AB, at any given Distance as C.

TAKE (with a Pair of Compasses) the nearest Distance between the given Point C and the Line AB.



With that Distance, and one Foot of the Compasses, any where in the Line AB, draw (on that Side where the Point C lieth) the Arch D, from the Point C draw a Line to touch the Arch D, and it is done; for the Line CD is parallel to the Line AB, as was required.

P R O B L E M II.

To bisect or divide a given Line into two equal Parts.

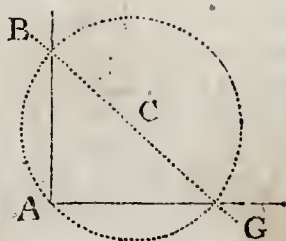
With any Distance (greater than Half the given Line AB), and one Foot of the Compasses on A, describe the Arch CD; with the same Distance and one Foot on B, cross the former Arch in C and D; by C and D draw a Line, and that will cut AB in E the Middle; as was required.



P R O B L E M III.

To erect a Perpendicular on the End of a given Line as AG.

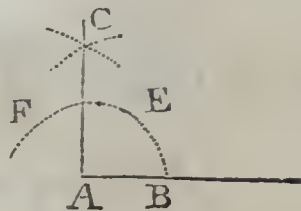
With any Distance, as from A to C in your Compasses, and one Foot in C describe a Circle, so that it may just touch the End of the given Line in A; from where that cuts the Line at G, and through C draw a Line to cut the Circle in B, from B draw the Line AB, which will be the Perpendicular required.



Or

6 GEOMETRICAL PROBLEMS.

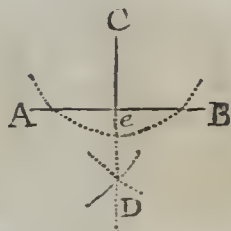
Or, with any convenient distance in your Compasses describe an Arch, as FB , set off the same distance from B to E , with one Foot in E describe an Arch, and with the same Distance, and one Foot in F , describe an Arch to cut the former Arch in C , from C , to A draw a Line, and it is done.



PROBLEM IV.

From a Point as at C , to let fall a Perpendicular on the Line AB .

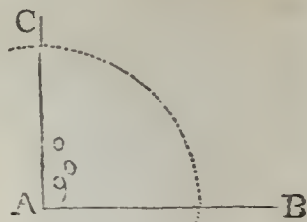
With one Foot in C describe an Arch to cut the given Line in A B , with one Foot in B describe an Arch; and with the same Radius, and one Foot in A , describe an Arch to cut the former in D , from D to C draw a Line, and it is done; for Ce is Perpendicular to AB , as was required.



PROBLEM V.

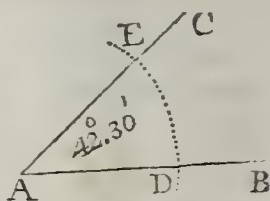
To make Plane Angles.

At A in the Line AB , to make a Right Angle, erect the Perpendicular AC , and it is done; for the Angle BAC is a Right Angle containing 90 Degrees.



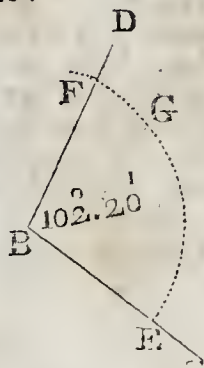
To make an Angle equal to any Number of Degrees.

Draw the Line AB , and take always a Chord of 60° from the Scale in your Compasses, and with one Foot in A describe the Arch DE to cut the Line AB in D ; take any Number of Degrees, suppose $42^\circ 30'$ from the Line of Chords, and lay it upon the Arch from D to E ; by A and E draw the Line AEC , and it is done; for the Angle BAC is an Acute Angle containing $42^\circ 30'$.



To make an Obtuse Angle equal to $102^{\circ} 20'$.

Draw the Line B C, and upon B describe an Arch as before, with a Chord of 60° , to cut B C in E, on that Arch set off E G equal to 90° , from G set off $12^{\circ} 20'$ towards F: by B and F draw the Line B F D and it is done; for the Angle C B D is an Obtuse Angle containing $102^{\circ} 20'$, as was required.



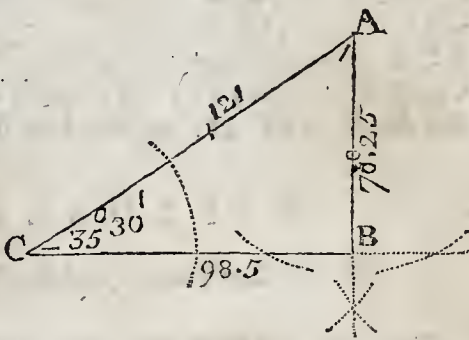
Inlike manner an Angle may be made, which shall contain any Number of Degrees required.

PROBLEM VI.

The Angles and Hypothenufe of a Right-angled Triangle given to find either of the Legs.

Given the Hypothenufe 121 Leagues, the Angle opposite to the Base $54^{\circ} 30'$, and consequently the other Angle $35^{\circ} 30'$; the Base and Perpendicular are required.

Draw the Line C B, and at C make an Angle equal to $35^{\circ} 30'$, by drawing the Line C A, take 121 Leagues in your Compasses (from any convenient Scale of equal Parts) and set that off from C to A, from A let fall the Perpendicular A B, to cut the Line C B, and it is done; for A B being measured on the same scale, will be 70.25 Leagues, and C B 98.5, as was required.



PROBLEM VII.

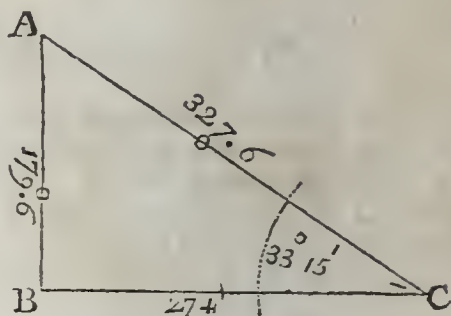
The Angles and one Leg of a Right-angled Triangle being given to find the Hypothenufe and other Leg.

The Angle A C B $33^{\circ} 15'$, the Leg B C 274 Miles, given to find the Hypothenufe, and the other Leg A B.

Draw

8 GEOMETRICAL PROBLEMS.

Draw the Base BC equal to 274, upon B erect the Perpendicular BA; from C draw the Line CA, making an Angle with BC of $33^{\circ} 15'$ to cut the Line BA in A, and it is done; for AC being measured on the same Scale that BC was, will be 327.6 Miles, and BA 179.6 Miles, as was required.

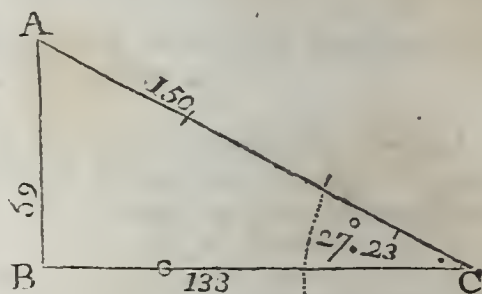


PROBLEM VIII.

The Hypotenuse and one Leg given to find the Angles and other Leg.

The Leg AB 69, the Hypotenuse 150, given to find the Angles and Leg BC.

Draw the Base BC, upon B erect the Perpendicular BA, upon which set off 69, take 150 in your Compasses, and with one Foot on A, lay the other on the Base, as at C, from C to A draw a Line, and it is done; for the Angle BCA being measured by a Chord of 60° will be $27^{\circ} 23'$, which being subtracted from 90° leaves the Angle A $62^{\circ} 37'$, and the Leg BC 133, as was required.



PROBLEM IX.

The Legs given to find the Angles and Hypotenuse.

The Leg AB 980, BC 690, given to find the Angle BAC or ACB, and the Hypotenuse AC.

Draw

10 GEOMETRICAL PROBLEMS.

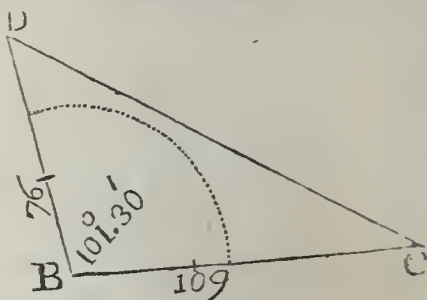
and it is done ; for the Angle D will be $120^{\circ} 43'$, the Angle B $27^{\circ} 28'$, and the Side D C 56.9. as was required.

PROBLEM XII.

Two Sides and their contained Angle given, to find either of the other Angles, and the third Side.

The Side B C 109, B D 76 Leagues, and Angle C B D $101^{\circ} 30'$, given to find the Angle B D C, or B C D, and Side C D.

Draw the Line B C 109, and B D, so as to make an Angle with B C of $101^{\circ} 30'$, which make equal to 76; join B C with a Right Line, and it is done ; for the Angle D, being measured by the Chord of 60° will be $47^{\circ} 32'$, Angle C $30^{\circ} 58'$, and the Side D C 144.8, as as required.

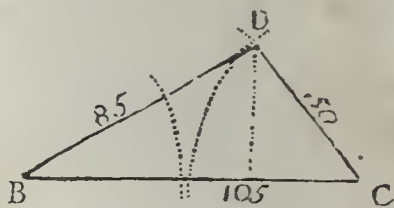


PROBLEM XIII.

The Three Sides given to find the Angles.

The Sides B C 105, B D 85, and C D 50 Miles, -given to find the Angles B D C, B C D, or C B D.

Draw the Line B C equal to 105, take C D 50 in your Compaffes, and with one Foot in C describe an Arch as at D, then take B D 85 in your Compaffes, and with one Foot in B cut the former Arch in D, join B D and D C, and it is done ; for the Angle B, being measured, will be found $28^{\circ} 4'$, Angle C $53^{\circ} 7'$, which being added together, is $81^{\circ} 11'$, their Sum, substracted from 180, leaves Angle D $98^{\circ} 49'$, as was required.



PLANE

PLANE TRIGONOMETRY:

OR, THE

DOCTRINE of PLANE TRIANGLES,

TEACHES the Mensuration of Triangles, by comparing the Sides and Angles together by known Analogies ; whereby Three Things being given, a Fourth may be found on Condition that one of them be a Side ; in which, Right Lines are applied to the Arches of a Circle, that the Proportion they bear to the Sides of a Plane Triangle, may be found.

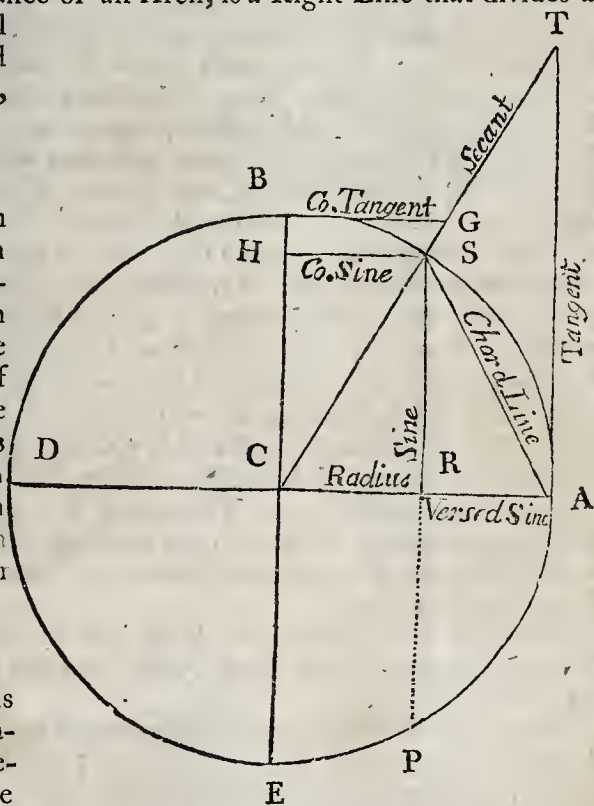
The Right Lines applied to a Circle are Chords, Sines, Tangents, and Secants.

I.

A Chord, or Substance of an Arch, is a Right Line that divides a Circle into two unequal Parts, and is a Chord to them both, as A S, and P S.

II.

A Right Sine of an Arch, is a Line drawn from one End or Termination of an Arch perpendicular to the Radius ; or it is Half the Chord of twice the Arch : So that R S is the Sine of the Arch S A and of the Arch S D, the Sum of which Arches make 180° , or a Semicircle.



III.

The versed Sine is that Part of the Diameter contained between the Right Sine and the Arch ; wherefore R A is the versed Sine of the Arch S A, and R D, the versed Sine of the Arch S D.

IV.

The Tangent of an Arch, is a Right Line drawn perpendicularly from one End of the Diameter, as A T.

V.

The Secant of an Arch is a Right Line drawn from the Centre through the Circumference, by which the Tangent is terminated; wherefore CT is the Secant of the Arches SA and SD .

VI.

The Sine Tangent, &c. of the Complement of any Arch is called the Co-Sine, Co-Tangent, &c. of the Arch: Thus HS is the Co-Sine and BG the Co-Tangent of the Arch AS .

Note, Sines, Tangents, and Secants, are said to be so-many Degrees as the Arch contains Parts of 360 Degrees; so that the Radius, being the Sine of a Quadrant or a Fourth Part of the Circumference, contains 90 Degrees: So that the Radius is always equal to the Sine of 90 Degrees.

From these Definitions it follows that the Chord of any Arch, and its Supplement to a Circle, is represented by the same Line: wherefore if the Chord of an Arch less than a Semicircle be given, the Chord of an Arch as much above a Semicircle as the other is deficient, is also given. From Definitions 2d, 4th, and 5th, it follows, that any Arch and its Complement to a Semicircle have one Right Sine, Tangent, and Secant, common to them both. Wherefore the Right Sine Tangent, and Secant of an Arch less than a Quadrant, is the same with the Right Sine, Tangent, and Secant of an Arch as much exceeding a Quadrant as the former is defective; and from Definition the 3d it follows that the versed Sine of an Arch greater than a Quadrant, is greater than the Radius: but the versed Sine of an Arch less than a Quadrant, is less than the Radius; and that the Sum and Difference of the Radius and Co-Sine of any Arch, shall be the versed Sine of that Arch and its Supplement to a Semi-circle; for $DC + CR = DR$ the versed Sine of the Arch DS ; and $AC - CR$, is the versed Sine of the Arch AS .

By comparing the similar Triangles CRS , and CBG , it appears, that the Co-Sine of an Arch is to the Right Sine, as the Radius is to the Tangent of the same Arch, and the Contrary; for $CR:RS::AC:CT$.

And, that the Cosine of an Arch, is to the Radius, as the Radius is to the Secant of the same Arch, and the Contrary; for $RC:SC::AC:CT$.

Hence the Radius is a mean Proportional between the Co-Sine and the Secant of the same Arch; wherefore, the Co-Sines and Secants of Arches are reciprocally proportional.

That the Right Sine of an Arch, is to the Radius, as the Tangent of the same Arch, is to its Secant, and the contrary; for $RS:SC::AT:TC$.

And the Tangent of an Arch, is to the Radius, as the Radius is to the

the Co-Tangent of the same Arch, and the Contrary; for $T A : A C :: C B : B G$.

Hence the Radius is a mean Proportional between the Tangent and Co-Tangent of an Arch; wherefore the Tangent of Arches and their Co-Tangents are reciprocally proportional.

That the Tangent of an Arch is to the Secant of the same Arch as the Radius is to the Secant of its Complement, and the contrary; for, $A T : T C :: C B : C G$.

The Chords, Sines, Tangents, and Secants, or versed Sines of similar Arches, are in Proportion to each other, as the Radii of those Circles.

By viewing the Figure it will appear, that if the longest Side of the Triangle $C R S$ be made the Radius of a Circle, the other Sides will be Sines of the Angles opposite to them; but if one of the Sides containing the Right Angle be made Radius, the other will be the Tangent of the Angle opposite to it, and the Hypotheneuse, or longest Side, the Secant of the same Angle.

Having explained the Properties of a Right-Angled Triangle at some Length, it being the Foundation of Plane and Mercator's Sailing; we shall now proceed to shew how to determine the several Lengths of the Sines, Tangents, and Secants, belonging to the several Arches, answering to every Degree and Minute of the Quadrant, in Parts of the Radius first given; and how to lay them down on the Plane Scale.

T H E

FUNDAMENTAL PROJECTION

O F T H E L I N E S O F

Sines, Tangents, and Secants on the Plane Scale.

1st. **W** I T H the Radius you intend for your Scale describe a Semicircle $A D B C$, and upon the Centre C raise the Perpendicular $C D$, (which will divide the Semicircle into two Quadrants, $A D$, $B D$); continue $C D$ directly to S , and upon B raise the Perpendicular $B T$, then draw the Right Lines $B D$ and $A D$.

2^{dly}. Divide the Quadrant $B D$ into 9 equal Parts, then will each of these be 10 Degrees. Again, you may subdivide each of these Parts into single Degrees: And these again, if your Radius will admit of it, into Minutes, or some Aliquot Parts of a Degree greater than Minutes.

3^{dly}. Set one Foot of the Compasses in B , and transfer each of the Divisions in the Quadrant $B D$, to the Right Line $B D$; then is $B D$ a Line of Chords.

4^{thly}. From the Points 10, 20, 30, &c. in the Quadrant $B D$, draw Right Lines parallel to $C D$ till they cut the Radius $C B$; then is the Line $C B$ divided into a Line of Sines, which must be numbered from C towards B .

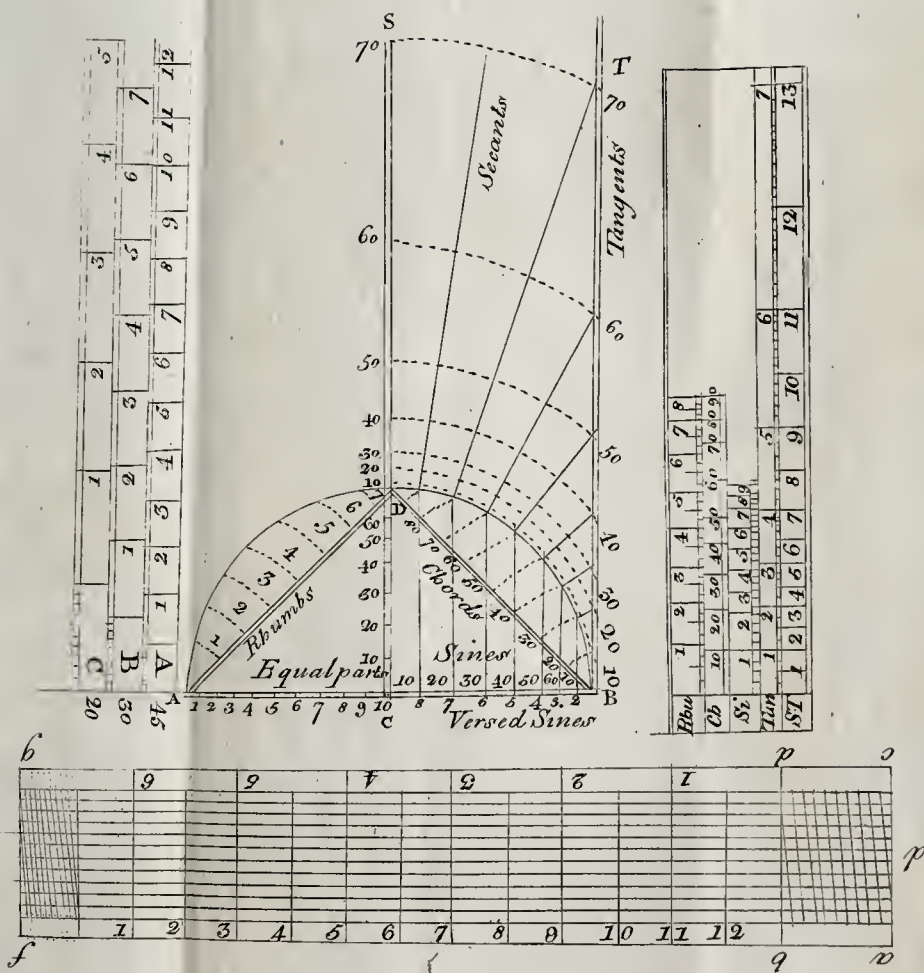
5^{thly}. If the same Line of Right Sines be numbered from B towards C , it will become a Line of Versed Sines; which may be continued to 180° , if the same Divisions be transferred on the other Side the Center C .

6^{thly}. From the Center C through the several Divisions in the Quadrant $B D$, draw Right Lines till they cut the Tangent $B T$; so will the Line $B T$ become a Line of Tangents.

7^{thly}. Setting one Foot of the Compasses in C , extend the other to the several Divisions, 10, 20, 30, &c. in the Tangent Line $B T$, and transfer these Extents severally into the Right Line $C S$; then will the Line $C S$ be a Line of Secants.

8^{thly}. Right Lines drawn from A to the several Divisions, 10, 20, 30, &c. in the Quadrant $B D$, will divide the Radius $C D$ into a Line of Semitangents.

9^{thly}. Divide the Quadrant $A D$ into 8 equal Parts, and from A transfer these Divisions severally into the Line $A D$; then is $A D$ a Line of Rhumbs, each Division answering to $11^\circ 15'$ upon the Line of Chords. The Use of this Line is for protracting and measuring





furing of Angles, according to the common Divisions of the Mariners Compass. If the Radius AC be divided into 100 or 1000, &c. equal Parts, and the Lengths of the several Sines, Tangents, and Secants, corresponding to the several Arches of the Quadrant, be measured thereby, and these Numbers be set down in a Table, each in its proper Column: you will by this Means have a Triangular Canon of Numbers, by which the several Cases in Trigonometry may be resolved. The Right Lines graduated as above, being placed severally upon a Ruler, do form the Instrument called the Plane Scale; by which the Sines and Angles of all Triangles may be measured. All Right Lines (as the Sides of Plane Triangles, &c. when they are considered simply as such, without having any Relation to a Circle) are measured by Scales of equal Parts; one of which is subdivided equally into 10, and this serves as a common Division to all the Rest. In most Scales an Inch is taken for a common Measure, to determine their Largeness and Number of Parts: that an Inch is divided into is generally set at the end of the Scale, as in the Scales A, B, and C; the Numbers 10, 20, 30, do shew that so many Parts of the Scales, A, B, C, are contained in an Inch. By any Scale of equal Parts divided as above, any Number less than 100 may be readily taken; but if the Number should consist of Three Places of Figures, the Value of the Third Figure can only be guessed at: wherefore in these Cases it is better to use such a Scale as D, called a Diagonal Scale, by which any Number of Three Figures may be exactly found.

Having prepared a Ruler of convenient Breadth for your Scale, (which may be an Inch more or less) First, near the Edges thereof, draw Two Right Lines af , cg , parallel to each other; then divide one of these Lines as af , into equal Parts, according to the Largeness you intend your Scale; and through each of these Divisions draw perpendicular Right Lines as far as the Line cg ; next divide the Breadth into 10 equal Parts; and through each of these Divisions draw Right Lines parallel to the former af and cg ; again, divide the Lengths a , b , c , d , each into 10 equal Parts; and from the Point d to the first Division in the Line AB , draw a Right Line, then parallel to that Line, draw Right Lines through all the other Divisions, and the Scale is done.

Besides the Lines already mentioned, there is another on the Plain Scale marked ML , which is joined to a Line of Chords; and shews how many Miles Easting or Westing make a Degree of Longitude in every Latitude; these several Lines are (generally) put on one Side of a Ruler 2 Feet long; and on the other Side are laid down a Scale of the Logarithms of the Sines, Tangents, and Numbers, which is commonly called Gunter's Scale; and as it is of general Use, it requires a particular Description.

DESCRIPTION and USE of G U N T E R ' s S C A L E .

GUNTER's Scale, hath set upon it these Eight Lines following :

1st. Sine Rhumbs (marked SR) is a Line which contains the Logarithm of the Sine of every Degree, Point, and Quarter Point of the Mariner's Compass, figured from the Left Hand towards the Right, with 1, 2, 3, 4, 5, 6, 7, to 8, where is a Brass Pin, and where it can, is divided into Halves and Quarters.

2d. Tangent Rhumbs (marked TR) also corresponds to the Logarithm of the Tangent of every Degree of the said Compass, and is figured 1, 2, 3, 4 at the Center, where is a Pin, and from thence towards the Left Hand with 5, 6, 7 ; it is also divided, where it can, into Halves and Quarters.

3. The Line of Numbers (marked Num.) contains the Logarithm of the Numbers, and is figured thus : near the Left Hand End it begins at 1, and towards the Right Hand is 2, 3, 4, 5, 6, 7, 8, 9 ; then 1 is the Middle, at which is a Brass Center Pin, going still on 2, 3, 4, 5, 6, 7, 8, 9, and 10 at the End, where is another Center Pin : (As this Line is generally used it requires a larger Description) The first 1 may be counted for 1, or 10, or 100, or 1000, and then the next 2 is accordingly 2, or 20, or 200, or 2000, &c. Again, the first 1 may be reckoned for 1 Tenth, or 1 Hundredth, or 1 Thousandth Part, &c. then the next is 2 Tenth, or 2 Hundredth, or 2 Thousandth Parts, &c. so that if the First 1 be esteemed 1, the Middle 1 is then 10, and 2 to its Right is 20, 3 is 30, 4 is 40, and 10 at the End is 100 ; again, if the First 1 is 10, the next 2 is 20, 3 is 30, and so on making the Middle 1 now 100, the next 2 is 200, 3 is 300, 4 is 400, and 10 at the End is now 1000. In like Manner if the First 1 be esteemed for 1 Tenth Part, the next is 2 Tenth Parts, and the Middle 1 is 1, and the next 2 is 2 ; and 10 at the End is now 10. Again, if the First 1 be counted 1 Hundredth Part, the next is 2 Hundredth Parts, the Middle 1 is now 10 Hundredth Parts, or 1 Tenth Part, and the next 2 is 2 Tenth Parts, and 10 at the End is now but 1 whole Number or Integer.

As the Figures are increased or diminished in their Value, so in like Manner must all the intermediate Strokes or Subdivisions be increased or decreased : that is, if the First 1 (at the Left Hand) be counted 1, then 2 (on the Right hand of it) is 2 ; and each Subdivision between them now is 1 Tenth Part, and so all the Way to the Middle 1, which now is 10, the next 2 is 20 ; now the
longer

longer Strokes between 1 and 2 are to be counted from 1 thus: 11, 12, (where is a Brass Pin) then 13, 14, 15, (sometimes a longer Stroke than the rest) then 16, 17, 18, 19, and 20 at the Figure 2; and all the shorter Strokes between these longer are now each to be counted for a Tenth Part, from the Middle 1 to the next 2, now 20, from whence the longer Strokes between the Figures are Units, thus, 21, 22, 23, &c. to 3, which now is 30, and the shorter Strokes between them, each now is a Tenth Part of an Integer; from 3 each short Stroke (or little Division) is 5 Tenth Parts of an Unit.

Again, if one at the Left Hand be 10, the Figure between it and the Middle 1 are common Tens; and the Subdivisions (between each Figure) are Units; and from the Middle 1 to 10 at the End, each Figure is so many Hundreds; and between these Figures each longer Division is 10; and from the Middle 1 to 2, each less Division is 2 Units; from 2 to the End, each shorter stroke is 5 Units.

From this Description it will be easy to find the Divisions representing a given Number, thus: Suppose the Point representing the Number 12 was required, take the Division at the Figure 1 in the Middle for the First Figure of 12, then for the second Figure count 2 Tenths (or longer Strokes) to the Right Hand, and this Last is the Point representing 12.

Again, suppose the Number 22 was required, the First Figure being 2, I take the Division to the Figure 2 for it, and for the Second Figure 2 count 2 Tenths onwards, and that is the Point representing 22.

Again, suppose 1728 was required, for the First Figure 1 I take the Middle 1, for the Second Figure 7 count onward as before, and that is 1700; then for the 2, the Third Figure count 2 Tenths from the Last, and it represents 1720; lastly, for the Fourth Figure 8, estimate 8 Tenths of the next small Division, or a little less than 10, this Point last found represents 1728.

Required the Point representing the Number 435? From the 4 in the Second Interval, count towards 5 in the Right, Three of the larger Divisions and one of the Smaller, and that will be the Division expressing 435; and the like of other Numbers, which by a little Practice is readily done.

All Fractions found in this Line must be Decimals; and if they are not, they must be reduced into Decimals, which is easily done by extending the Compasses from the Numerator to the Denominator, that Extent laid upon 1 in the Middle will reach to the Decimal required.

Example, required the Decimal Fraction equal to $\frac{3}{4}$? Extend from 4 to 3, that Extent will reach from 1 in the Middle to .75 towards the Left Hand; the like may be observed of any other Vulgar Fraction.

18 The Description and Use of GUNTER'S SCALE.

Multiplication is performed on this Line by extending from 1 to the Multiplier, that Extent will reach from the Multiplicand to the Product.

Suppose for Example it was required to find the Product of 16 multiplied by 4 : Extend from 1 to 4, that Extent will reach from 16 to 64, the Product required.

Division being the Reverse of Multiplication, therefore extend from the Divisor to 1, that Extent will reach from the Dividend to the Quotient.

Suppose 64 is to be divided by 4, extend from 4 to 1, that Extent will reach from 64 to 16, the Quotient. The same with any other Numbers.

Proportion, or the Rule of Three being performed by Multiplication and Division, therefore extend from the First Term to the Second, that Extent will reach from the Third to the Fourth.

Example, If the Diameter of a Circle be 7 Inches, and the Circumference 22, what is the Circumference of another Circle, the Diameter of which is 14 Inches :

Extend from 7 to 22, that Extent will reach from 14 to 44, the Circumference required.

In like Manner may any other Proportion be worked of any Denomination, which makes this Line of general Use, particularly in measuring of Superfices and Solids, which is done by extending from 1 to the Breadth, that Extent will reach from the Length to the Superficial Content.

Example, suppose a Plank or Board 15 Inches broad, and 27 Feet Long, the Content of which is required :

Extend from 1 to 1 Foot 3 Inches, that Extent will reach from 27 Feet to 33.75 Feet, the Superficial Content ; or extend from 12 Inches to 15 Inches, that Extent will reach from 27 Feet to 33.75 Feet.

The Solid Content of any Bale, Box, Chest, &c. is found by extending from 1 to the Breadth, that Extent will reach from the Depth to a Fourth Number, and the Extent from 1 to that Fourth Number will reach from the Length to the Solid Content.

Example 1st. What's the Content of a Square Pillar, whose Length is 21 Feet 9 Inches, and Breadth 1 Foot 3 Inches ?

The Extent from 1 to 1.25 will reach from 1.25 to 1.56, the Content of 1 Foot in Length ; again, the Extent from 1 to 1.56 will reach from the Length 21.75 to 33.8, the Solid Content in Feet.

Example 2d. Suppose a Square Piece of Timber 1.25 Feet Broad, .56 Deep, and 36 Feet Long be given to find the Content : Extend from 1 to 1.25, that Extent will reach from .56 to 7 ; then extend from 1 to 7, that Extent will reach from 36 to 25.2, the Solid Content. In like Manner may the Contents of any Bales, &c. be found, which divided by 40 will give the Tonage.

3d. The

The Description and Use of GUNTER'S SCALE. 19

3d. *The Line of Sines* (marked SINES) begin at the Left Hand, and Figured thus: 1, 2, 3, &c. to 10; then 20, 30, 40, &c. to 90, ending at the Right Hand, where is a Brass Center Pin: These Figures never change their Value or Denomination, being here (and in all Lines under it) called Degrees.

4th. *The Line of Versed Sines* (marked V. S.) begins at the Right Hand against 90, in the Sines, and from thence Figured towards the Left Hand, thus: 10, 20, 30, 40, &c. ending at the Left Hand End about 169 Degrees; the Subdivisions are from 10 to 30, each are 2 Degrees; from thence to 90, (it is single Degrees); and from thence to the End; it is divided each into 15 Minutes.

5th. *The Line of Tangents* (marked TAN.) begin at the Left Hand as the Sines do; from thence Figured to the Right Hand, thus: 1, 2, 3, &c. to 10, and so on 20, 30, 40, and 45 at the Right Hand, where is a little Brass Center Pin, just under and even with 90 in the Sines; from thence back again it is Figured 50, 60, 70, 80, &c. to 89, ending at the Left Hand where it began at 1 Degree: The Subdivisions of this Line are the same as those of the Sines.

6th. *The Line of Meridional Parts* (marked MER.) begins at the Right Hand, and numbered thus: 10, 20, 30, &c. to the Left Hand, where it ends at 87 Degrees. This Line, with the Line of Equal Parts (marked E. P.) under it, are used together, only in Mercator's Sailing. The uppermost Line contains the Degrees of the Meridian or Latitude, in a Mercator's Chart; and the lower is the Equator, and contains the Degrees of Longitude.

THE USE OF THE LOGARITHMS.

LOGARITHMS are a Series of Numbers, invented by Lord Napier, a Scotch Nobleman, by which the Work of Multiplication may be performed by Addition; and the Operation of Division may be done by Subtraction; for if the Logarithm of the Multiplicand be added to the Logarithm of the Multiplier, that Sum will be the Logarithm of the Product; and if from the Logarithm of the Dividend you Subtract the Logarithm of the Divisor, the Remainder will be the Logarithm of the Quotient. Again, if the Logarithm of any Number be divided by 2, the Quotient will be the Logarithm of the Square Root of that Number; or if the Logarithm of any Number be divided by 3, the Quotient will be the Logarithm of the Cube Root of that Number.

In the first Page of the Tables you will find the Logarithm of the Numbers from 1 to 100, which are continued to 10,000. To find Logarithm of any Number proceed thus: 1st. If the Number be less than 100, suppose 45, look for 45 in the Column marked N°. opposite to which is 1.65321, the Logarithm required. Again, suppose the Logarithm 741 is wanted, look for 741 in the Column marked N°. opposite to that is 2.86982, the Logarithm; but if the Number consists of more than 3 Places, suppose 5738, find the first 3 Figures 573 in the Column marked N°. and Right over and under 8 stands 2.75876; but as the Number is above 3 Places of Figures, the Figure or Index must be called 3, and then it will stand thus, 3.75876, the Logarithm required. On the Contrary, when a Logarithm is given to find the Number belonging to it, look among the Logarithms for the nearest to it, opposite which, in the Column of N°. will be found the Number required. Suppose for Example, the Logarithm 2.75662 was given, I find the nearest to it in the Table is 2.75664, opposite to that is 571, the Number required. Again, suppose the Logarithm 3.74763 was given to find its Number, looking in the Table I find nearest thereto under 3, and opposite to 559, now because the Index is 3, I call it 5593, which is the Number required; for when the Number is under 10 the Index is always 0; from 10 to 100 the Index is 1; from 100 to 1000 the Index is 2; from 1000 to 10,000 the Index is 3; from 10,000 to 100,000 the Index is 4, &c.

To find the Logarithm of an Absolute Number and a Decimal.

If the Decimal consists of one Place and the whole Number be under 100, look for the whole Number and Decimal as if it was an Absolute Number in the Column of Numbers, opposite to that will be the Logarithm required, observing to separate the last Figure in
the

the Number for a Decimal, and to call the Index 1 if above 10 and under 100; but if under 10 the Index is 0. Required the Logarithm of 57.5? opposite to 575 is 2.75967, calling the Index 1 it will be 1.75967, the Logarithm of 57.5.

Having the Logarithm, the Number is found by the Inverse of the above, as for Example:

Required the Number answering to the Logarithm 2.98798? Looking in the Table I find that Logarithm under (7) and opposite 972, therefore 972.7 is the Number sought.

When there are two places of Decimals, find the whole Number, and the first Place of the Decimal in the Column of N^o . as before, and the last Figure in the Column marked | 1 | 2 | 3 | &c. above, and at the Angle of Meeting will be the Logarithm required. Example, Required the Logarithm of 44.49? look for 444, and Right over and under 9 is 2.64826, making the Index 1 it will be 1.64826, the Logarithm of 44.49; having the Logarithm, the Number is found as before.

Example, Required the Number answering to this Logarithm 0.75450? Looking in the Table I find that Logarithm under 2, and opposite to 568 in the Column of Numbers; now as the Index is (0) the 5 only is a whole Number, and 68 set before the 2 above, will make the Decimal 682, consequently the Number is 5.682.

To find the Logarithm of the Sine, Tangent, or Secant belonging to any Number of Degrees and Minutes required.

If the required Degrees be less than 45, seek the Degrees on the Top, and the Minutes in the left Hand Column marked M, against which in the Column signed at the Top with the proposed Name, stands the Sine, Tangent, and Secant required; but when the Degrees given are more than 45, seek the Degrees at the Bottom, and the Minutes in the Right Hand Column marked M at the Bottom, and the proposed Name at the Bottom. Here it may be observed that the Degrees at the Top, and Minutes at the Left Hand Column added to the Degrees at the Bottom, and Minutes in the Right Hand Column always make 90° : hence, if at Sine be looked for, the Complement to it will be found in the adjoining Column: the same of Tangents and Secants.

Example 1st. Required the Logarithm of the Sine $28^\circ 37'$?

Find 28° at the Top of the Page, and in the Left Hand Column marked M at the Top find 37, against which in the Column marked with the word Sine, stands 9.68029, the Logarithm of the Sine of $28^\circ 37'$ required; the same may be observed of Tangents and Secants.

Example 2d. Required the Logarithm of the Tangent of $67^\circ 45'$?

Find 67° at the Bottom of the Page, and 45 in the Right Hand Column marked M at the Bottom, against this in the Column marked Tangent at the Bottom stands 10.38816, which is the Logarithm required.

Having the Sine, Tangent, or Secant, the Co-Sine, Co-Tangent, and Co-Secant are always found in the adjoining Columns.

22 THE USE OF THE LOGARITHMS.

The Logarithm of any Number of Degrees above 90° is found by subtracting the given Degrees from 180° , and taking the Logarithms of the Remainder.

To find the Complement Arithmetic of any Logarithm given :

The Complement Arithmetic of a Logarithm is what it wants of 10.00000, or 20.00000, and is used to avoid Subtraction ; for finding it this in the Rule : take the Residue or Remainder of the first Figure to 9, and so of the Rest until you come to the last Figure, of which take its Remainder under 10, and it is done.

Example 1st. I would have the Complement Arithmetic of 9.62595 :

For the first Figure 9 write 0 ; for 6, 3 ; for 2, 7 ; for 5, 4 ; for 9, 0 ; and for the last Figure 5 write 5 ; and so you have 0.37405, for the Complement Arithmetic sought.

Example 2d. The Complement Arithmetic of 10.33133 :

For 0, (always rejecting the first Figure, when there are two Figures in the Characteristic) write 9 and so on as before directed, and then you will have 9.66867, which is the Complement Arithmetic of 10.33133.

Or thus :

From	10.00000	From	20.00000
Take	9.62595	Take	10.33133
Comp. Arith. required.	0.37405	Comp. Arith. required.	9.66867

The Logarithm for Degrees, Minutes, and Seconds is found by taking the Difference between the next greater and lesser Logarithm ; and saying as $60''$: is to that Difference :: so is the Seconds given : to a fourth Number, which fourth Number being added to the Left Hand of the next less Logarithm gives the Logarithm required. By the reverse of this, when the Logarithm is given, the Seconds may be found.

But if the given Seconds be $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, or nearly any other even Parts of a Minute, the like Parts may be taken of the difference of the Logarithms, and added to the next less Logarithm, and that will be the Logarithm of the Degrees, Minutes, and Parts of a Minute required.

The same may be observed of Natural Sines.

The Solution of the several Cases in Right-angled and Oblique Plane Trigonometry.

Notwithstanding what has been said, it may not be improper to observe,

That

That the Chord of 60° , Sine of 90° , and Tangent 45° of any Circle are always equal to the Radius.

The Co-Sine, Co-Tangent, Co-Secant and Co-versed Sine of an Arch is the Right Sine, Tangent, Secant, and Versed Sine of the Complement of that Arch.

That all Circles, whether great or small, are supposed to be divided into 360 equal Parts called Degrees, and each of these Degrees divided into 60 equal Parts called Minutes; the fourth Part of a Circle is called a Quadrant or 90° , the Half is called a Semi-circle or 180° .

The Complement of any Angle is what it wants to complete 90 Degrees.

The Supplement of any Angle is what it wants to complete 180 Degrees.

All Angles are measured by an Arch of a Circle described upon their Angular Points with the Chord of 60 Degrees, and are esteemed greater or less, according to the Number of Degrees contained between the Legs; but the Sides are measured by a Scale of equal Parts.

The fewest Number of Right Lines that can include a Space are three, which is called a Triangle, and consists of six Parts, which are three Sides and three Angles.

The three Angles are always equal to a Semi-circle or 180 Degrees; therefore, if two of the Angles be given, the third is found by subtracting the Sum of the two given Angles from 180 Degrees, the Remainder will be the third Angle; and if one of the Angles be given, the Sum of the other two is found by subtracting the given Angle from 180 Degrees, the Remainder will be the Sum of the other two Angles; but in a Right-angled Triangle (or that which hath one of its Sides perpendicular to the other), the Right Angle always contains 90 Degrees, and the other two contain 90 Degrees between them: Therefore, having one of the Acute Angles given, the other is always found by subtracting the given Angle from 90 Degrees, the Remainder will be the other Angle.

Three Letters signify an angle: The middle one denotes the Angular Point, and the other two the Legs that include it.

Degrees are always marked with a Cypher over them, and Minutes with a Dash.

Sides or Angles, being given, are always marked with a Dash; but, if required, with a Cypher.

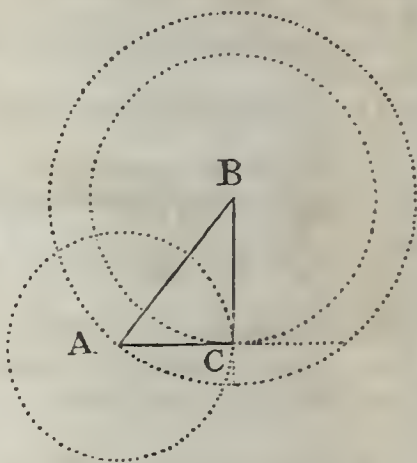
The Logarithm of any Angle exceeding 90 Degrees is found by subtracting it from 180 Degrees, and taking the Logarithm of the Remainder.

The Solutions of the several Cases in plain Trigonometry depend upon four Propositions, called AXIOMS; which should be got perfectly by heart.

A X I O M I.

In any Right-angled plane Triangle, if the Hypothenufe, or longest Side, be made the Radius of a Circle, the other two Sides, or Legs, will be the Sines of their opposite Angles: But if either of the Legs, including the Right Angle, be made Radius, the other Leg becomes the Tangent of its opposite Angle, and the Hypothenufe the Secant of the same Angle*.

For, in the Triangle ABC , let AB be made the Radius of a Circle, and with one Foot of the Compasses on A or B describe a Circle, it is plain that the Leg BC will be the Sine of the Angle A , and AC the Sine of the Angle B : But if AC be made Radius, BC becomes the Tangent of the Angle A , and BA the Secant of the same Angle.



Again, by making BC Radius, AC will be Tangent, and AB the Secant of the Angle B : Hence it is plain that the different Sides take their Names according to which side is made Radius.

NOTE 1st. To find a Side, any Side may be made Radius: Then say, as the Name of the Side given is to the name of the Side required, so is the Side given to the Side required.

But to find an Angle, one of the given sides must be made Radius: Then, as the Side made Radius, is to the other Side, so is the Name of the first Side, (which is always Radius), to the Name of the second Side; which fourth Proportional must be found among

*NOTE. As this Axiom shews how to work any Proportion in Plane, Traverse, or Mercator's Sailing; therefore, the Terms of Plane Sailing may be applied to the Right-angled Triangle, and then proceed to Plain Sailing immediately, without going through Trigonometry, if the Pupil's Time be short; and may be rendered thus:

In any Case in Plane Sailing, if the Distance be made Radius, the Departure will be the Sine, and the Difference of Latitude the Sine-Complement of the Course.

But if the Departure is made Radius, the Difference of Latitude will be the Tangent, and the Distance the Secant of the Complement of the Course.

And if the Difference of Latitude is made Radius, the Departure will become the Tangent, and the Distance the Secant of the Course.

the Sines or Tangents, &c to be determined by the Side made Radius, and against it is the Angle required.

In a Right-angled Triangle you must always have two Sides, or the Angles and one Side given, to find the rest.

To work Proportions by Logarithms, observe this general Rule:

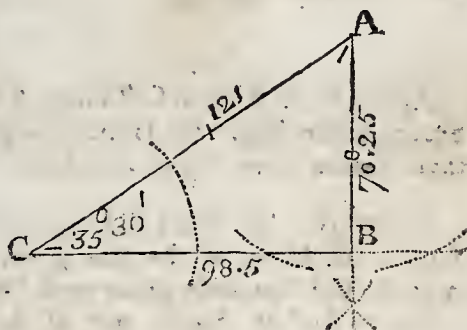
Add the Logarithm of the second and third Terms together, and from that Sum subtract the Logarithm of the first Term, the Remainder is the Logarithm of the fourth Term or Number sought. When an Angle is greater than 90 Degrees, the Sine, Tangent, and Secant of the Supplement is to be used.

C A S E I.

The Angles and Hypothenuse given, to find either of the Legs.

Given, the Hypothenuse 121 Leagues; the Angle opposite to the Base $54^{\circ} 30'$; and consequently, the other Angle $35^{\circ} 30'$; the Base and Perpendicular are required.

For the Construction see Problem VI. in Geometry.



By making the Base Radius, the Proportion, by AXIOM I.
will be,

As Secant Angle C — $35^{\circ} 30'$	10.08931		
Is to the Hypothenufe 121	2.08278	From $90^{\circ} 0'$	
So is Radius —	10.00000	Take $54 30$	
	12.08278	Remains $35 30$	= Angle C
	10.08931		
To the Side B C 98.5	1.99347		
As Secant Angle C $35^{\circ} 30'$			10.08931
Is to the Hypothenufe 121			2.08278
So is the Tangent Angle C $35^{\circ} 30'$			9.85327
			11.93605
			10.08931
To the Side A B 70.26			1.84674

By making the Perpendicular Radius, the Proportion,
by AXIOM I. is,

As Sec. Ang. A $54^{\circ} 30'$	10.23605	As Sec. Ang. A $54^{\circ} 30'$	10.23605
Is to the Hyp. 121	2.08278	Is to Hyp. 121	2.08278
So is Radius —	10.00000	So is Tan. Ang. A $54^{\circ} 30'$	10.14673
	12.08278		12.22951
	10.23605		10.23605
To the Side A B 70.26	1.84673	To the Side B C 98.5	1.99346

By making the Hypothenufe Radius, it will be,

As Radius —	10.00000	As Radius —	10.00000
Is to the Hyp. 121	2.08278	Is to the Hyp. 121	2.08278
So is Sine Ang. A $54^{\circ} 30'$	9.91069	So is Sine Ang. C $35^{\circ} 30'$	9.76395
	11.99347		11.84673
	10.00000		10.00000
To the Side B C 98.5	1.99347	To the Side A B 70.26	1.84673

Hence it is plain that whatever Side is made Radius, the Result will be the same.

BY

BY GUNTER'S SCALE.

In all Proportions wrought by Gunter's Scale, when the first and second Terms are of the same Kind, then the Extent from the first Term to the second will reach from the third to the fourth.

Or when the first and third Terms are of the same Kind :

The Extent from the first Term to the third will reach from the second to the fourth ; that is, set one Point of the Compasses on the Division expressing the first Term, and extend the other Point to the Division expressing the second (or third) Term ; then, without altering the Opening of the Compasses, set one Point on the Division representing the third Term (or second Term), and the other Point will fall on the Division shewing the fourth Term or Answer.

Now in the last Case it will be thus :

Extend from Radius or 90° to $54^\circ 30'$ on the Line of Sines ; that Extent will reach from the Hypotenuse 121 to the Base 98.5 on the Line of Numbers.

2dly. Extend from Radius to $35^\circ 30'$ on the Line of Sines ; that Extent will reach from the Hypotenuse 121 to the Perpendicular A B 70.26 on the Line of Numbers.

Observe the like in all that follows, except in those Proportions where the word *Secant* is mentioned ; which may be readily wrought, by considering the Hypotenuse Radius, as in the last Case.

NOTE. The Radius according to the Nature of the Proportion, may be any of these, viz.

8 Points on the Line of Sine Rhumbs $\parallel$ 90° on the Line of Sines.

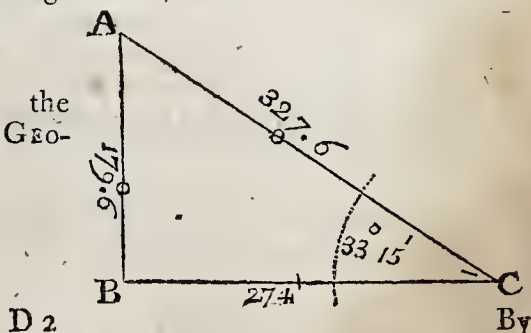
4 Points on the Line of Tan. Rhumbs $\parallel$ 45° on the Line of Tangs.

C A S E II. AND III.

The Angles and one Leg given, to find the Hypotenuse and other Leg.

The Angle A C B $32^\circ 15'$, the Leg B C 274 Miles, given, to find the Hypotenuse and other Leg.

The Construction is the same as Problem VII. in GEOMETRY.



By making the Base Radius, the Proportion will be,

As Radius	—	10.00000	As Radius	—	10.00000
Is to the Base	274	2.43775	Is to the Base	274	2.43775
So is Tan. Ang. C	33° 15'	9.81666	So is Sec. Ang. C.	33° 15'	10.07764
		<u>12.25441</u>			<u>12.51559</u>
		10.00000			10.00000
To the Perpend.	179.6	<u>2.25441</u>	To the Hypoth.	327.6	<u>2.51559</u>

By making the Perpendicular Radius.

As Tan. Ang. A	56° 45'	10.18334	As Tan. Ang. A	56° 45'	10.18334
Is to the Base	274	2.43775	Is to the Base	274	2.43775
So is Radius	—	10.00000	So is Sec. Ang. A	56° 45'	10.26099
		<u>12.43775</u>			<u>12.69874</u>
		10.18334			10.18334
To the Perpend.	179.6	<u>2.25441</u>	To the Hypoth.	327.6	<u>2.51540</u>

By making the Hypothenuſe Radius.

As the Sine Ang. A	56° 45'	9.92235	As Sine Ang. A	56° 45'	9.92235
Is to the Base	274	2.43775	Is to the Base	275	2.43775
So is Sine Ang. C	33° 15'	9.73901	So is Radius	—	10.00000
		<u>12.17676</u>			<u>12.43775</u>
		9.92235			9.92235
To the Perpend.	179.6	<u>2.25441</u>	To the Hypoth.	327.6	<u>2.51540</u>

By G U N T E R.

‘Extend from 56 Degrees 45 Minutes to 33 Degrees 15 Minutes, or the Line of *Sines*, that Extent will reach from the Base 274 to the Perpendicular 179.6 on the Line of *Numbers*.’

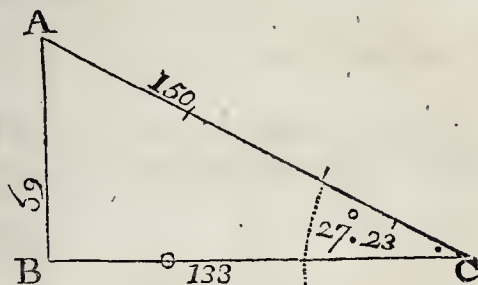
‘2dly. Extend from 56 Degrees 45 Minutes to Radius on the Line of *Sines*, that Extent will reach from the Base 274 to the Hypothenuſe 327.6, on the Line of *Numbers*.’

CASE IV. AND V.

The Hypothenufe and one Leg given, to find the Angles and other Leg.

The Leg A B 69, the Hypothenufe 150 given, to find the Angle A C B, or B A C, and Leg B C.

The Construction is the same as Problem VIII. in GEOMETRY.



By making the Hypothenufe Radius.

As the Hypothenufe 150	2.17609	As Radius	—	10.00000
Is to Radius	—	Is to the Hypoth.	150	2.17609
So is Perpendicular 69	1.83885	So is S. Ang. A 62° 37'		9 94839
	<u>11.83885</u>			<u>12.12448</u>
	2.17609			10.00000
To Sine Angle C 27° 23'	9.66276	To the Base	133.2	2.12448

By making the Perpendicular Radius.

As the Perpend. 69	1.83885	As Radius	—	10.00000
Is to Radius	—	Is to the Perpend. 69		1.83885
So is the Hypoth. 150	2.17609	So is Tan. Ang. 62° 37'		10.28568
	<u>12.17609</u>			<u>12.12453</u>
	1.83885			10.00000
To Sec. Ang. A 62° 37'	10.33724	To the Base	133.2	2.12453

By G U N T E R.

'Extend from the Hypothenufe 150, to the Perpendicular 69, on the Line of *Numbers*, that Extent will reach from Radius to Sine Angle C 27 Degrees 23 Minutes, on the Line of *Sines*.

2dly 'Extend from Radius to Sine Angle A 62 Degrees 37 Minutes, that Extent will reach from the Hypothenufe 150 to the Base 133.2 on the Line of *Numbers*.'

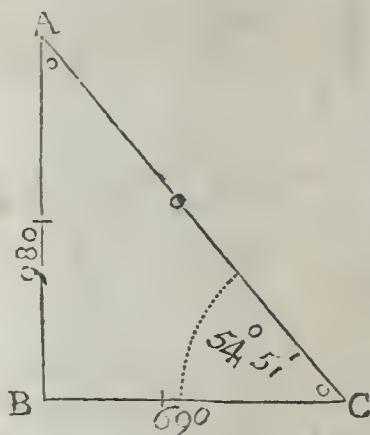
CASE

CASE VI. AND VII.

The Legs given to find the Angles and Hypothenufe.

The Legs AB 980, BC 690 given, to find the Angle BAC , or ACB , and the Hypothenufe AC .

The Construction is the same as Problem IX. in GEOMETRY.



By making the Base Radius.

As the Base	690	2.83885	As Radius	—	10.00000
Is to Radius	—	10.00000	Is to the Base	690	2.83885
So is the Perpend.	980	2.99123	So is Sec. Ang. C	$54^{\circ} 51'$	10.23979
		12.99123			13.07864
		2.83885			10.00000
To Tan. Ang. C	$54^{\circ} 51'$	10.15238	To the Hypoth.	1198	3.07864

By making the Perpendicular Radius.

As the Perpend.	980	2.99123	As Radius	—	10.00000
Is to Radius	—	10.00000	Is to the Perpend.	980	2.99123
So is the Base	690	2.83885	So is Sec. Ang. A	$35^{\circ} 9'$	10.08743
		12.83885			13.07866
		2.99123			10.00000
To Tan. Ang. A	$35^{\circ} 9'$	9.84762	To the Hypoth.	1198	3.07866

By G U N T E R.

'The Extent from 690 to 980 on the Line of *Numbers*, will reach from Radius (or 45 Degrees) to 54.51 on the Line of *Tangents*.'

2dly. 'The Extent from Sine Angle A 35 Degrees 9 Minutes to Radius, (or 90 Degrees) will reach from the Base 690 to the Hypothenufe 1198, on the Line of *Numbers*.'

OBLIQUE TRIGONOMETRY.

A X I O M II.

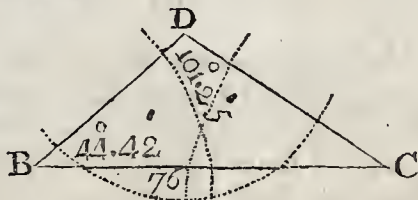
IN all Plane Triangles, the Sides are in direct Proportion to the Sines of their opposite Angles*.

C A S E I.

Two Angles and one Side given, to find either of the other Legs.

The Angle BDC $101^{\circ} 25'$, and CBD $44^{\circ} 42'$, and the Leg BC 76 given, to find the Sides CD and BD .

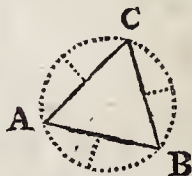
NOTE. The Construction the same as Problem X. in GEOMETRY.



The Proportion by AXIOM II. will be,

As Sine Angle D	$101^{\circ} 25'$	—	9.99132
Is to the Side B C	76	—	1.88081
So is Sine Angle B	$44^{\circ} 42'$	—	9.84720
			11.72801
			9.99132
To the Side D C	54.53	—	1.73669

* Let the Triangle ABC be circumscribed with a Circle its plain, that each Side becomes a Chord to its respective Arch; from hence, as the Arch-Chord of $A C$ is to the Chord of the Arch $C B$, so is the Side $A C$ to the Side $C B$.



Now it has been shewn that half the Chord is the Sine of the Arch subtended by that Chord; therefore in the Triangle ABC , the Sines of the Angles will be as the Halves of their opposite Sides; and since the Halves are as Wholes, it follows, that the Sines of the Angles are as their opposite Sides; that is $AC : CB :: \text{Sine Ang. } B : \text{to Sine Ang. } A$, &c.

As Sine Angle C - $31^{\circ}49'$ —	9.72198		180. 0
Is to the Side B D 65 —	1.81291	The Supplem.	59.17 of Ang. D
So is Sine Angle B 27.28 —	9.66392		
	11.47683		120.43 Angle D
	9.72198		31.49 Angle C
To the Side D C - 56.88	1.75485		152.32 their Sum
			180. 0
			152.32 sum subtr.
			27.28 Angle B

Here it may be proper to observe, that if the given Angle be Obtuse, the Angle sought will be Acute; but when the given Angle is Acute, and opposite to a Lesser given Side, then the required Angle is doubtful, whether Acute or Obtuse; it ought, therefore, to be determined before the Operation. For its plain the above Proportion produces $59^{\circ} 17'$ for the required Angle; but as it is Obtuse, its Supplement to 180 Degrees must be taken, viz. $120^{\circ} 43'$.

BY G U N T E R.

'The Extent from 65 to 106 on the Line of *Numbers*, will reach from $31^{\circ} 49'$ to $59^{\circ} 17'$ on the Line of *Sines*.'

2dly. 'The Extent from $31^{\circ} 49'$ to $27^{\circ} 28'$ on the Line of *Sines*, will reach from 65 to 56.88 on the Line of *Numbers*.'

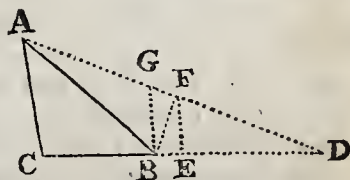
A X I O M III.

In every Plane Triangle it will be, as the Sum of any two Sides, is their Difference, so is the Tangent of half the Sum of the Angles opposite these Sides to the Tangent of half their Difference.

'Which half Difference, being added to half the Sum of the Angle, gives the greater; but if subtracted, the Remainder will be the lesser Angle*.'

* Produce the lesser Leg CB of the Triangle ABC, till BD become equal to BA; then bisect DC in E; join AD and bisect it also in F, which (by 2. 6. Eucl.) will be perpendicular to AD, and draw EF, which by (2. 6. Eucl.) will be parallel to AC. Then will the Angles ABF = FBD = $\frac{1}{2}$ ABD, which external Angle ABD is (32. 1. Eucl.) = ABC + BCA that is the Sum of the opposite Angles required.

Then draw BG parallel to CA, so will the Angle GBA be (by 29. 1. Eucl.) equal to its alternate one BAC. And if from $\frac{1}{2}$ the Sum of the

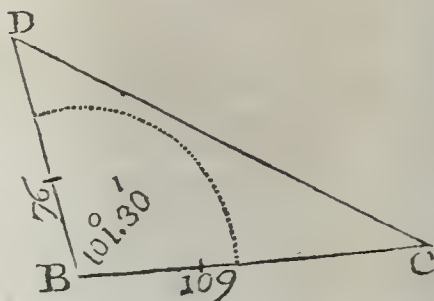


CASE IV. AND V.

Two Sides, and their contained Angle, given, to find either of the other Angles and third Side.

The Side BC 109, BD 76 Leagues, and the Angle CBD $101^{\circ} 30'$, given to find the Angle BDC, or BCD, and Side CD.

The Construction is the same as Problem XII. in Geometry.



Side BC	109	—	109	—	$180^{\circ} 0'$
BD	76	—	76	—	$101^{\circ} 30'$
their Sum	<u>185</u>		<u>33</u>	their Diff.	<u>$78^{\circ} 30'$</u>
					$\frac{1}{2}$ <u>$39^{\circ} 15'$</u>
					Sum of two Angles D & C

opposite Angles, you take the lesser Angle, that is, if from Angle ABF you take the Angle GBA; there will remain the Angle GBF = half the Difference of the opposite Angles: And so also, if from CE, $\frac{1}{2}$ the Sum of the Legs, you take CB the lesser Leg, there will remain BE = $\frac{1}{2}$ the Difference of the Legs. And since the Angle ABF is Right-angled, if BF be made Radius, AF will be the Tangent of the Angle ABF, (that is, the Tangent of $\frac{1}{2}$ the Difference of the opposite Angles); and in the little Triangle GBF, GF will be the Tangent of the Angle GBF, (that is the Tangent of half the Difference of the opposite Angles): But the Segments of the Legs of any Triangle cut by Lines parallel to the Base, being (by Eucl. 2. 6.) proportional EC : CB :: FA : FG, that is, half the Sum of the Legs is to half their Difference, as the Tangent of half the Sum of the opposite Angles is to the Tangent of half their Difference: But Wholes are as their Halves; wherefore the Sum of the Legs is to their Difference, as the Tangent of half the Sum of the Angles opposite, is to the Tangent of half their Difference.

The Proportion by AXIOM III. is,

As the Sum of the Sides B C and B D = 185	—	2.26717
Is to their Difference	33	1.51851
So is Tang. of $\frac{1}{2}$ the Sum of the Angles C and D $39^{\circ} 15'$		9.91224
		11.43075
		2.26717
To the Tan. of $\frac{1}{2}$ the Difference of the Angs. C & D $8^{\circ} 17'$		9.16358
To $\frac{1}{2}$ the Sum of the Angles D and C	—	$39^{\circ} 15'$
Add $\frac{1}{2}$ the Difference of the Angles C and D	—	8 17
Gives the greater Angle D		47 32
Subtracted, gives the lesser Angle C		30 58

Having the Angles, the Side is found by AXIOM II.
for it will be,

As Sine Angle D $47^{\circ} 32'$	—	9.86786
Is to the Side B C 109	—	2.03743
So is Sine Angle B $101^{\circ} 30'$	—	9.99119
		12.02862
		9.86786
To the Side D C required 144.8	—	2.16076

By G U N T E R.

‘The Extent from 185 to 33 on the Line of *Numbers*, will reach from $39^{\circ} 15'$ to $8^{\circ} 17'$ on the Line of *Sines*.’

2dly. ‘The Extent from Angle D $47^{\circ} 32'$ to $78^{\circ} 30'$ (the Supplement of Angle B) on the Line of *Sines*, will reach from the Side B C 109 to 144.8, the Side D C required on the Line of *Numbers*.’

A X I O M IV.

In any Plane Triangle, as the Base or greatest Side is to the Sum of the other two Sides, so is the Difference of the Sides to the Difference of the Segments of the Base; made by a Perpendicular let fall from the Angle opposite to the Base.

‘And if half the Difference of the Segments be added to half their Sum, it will give the greater Segment; but if subtracted, the Remainder will be the lesser Segment.’

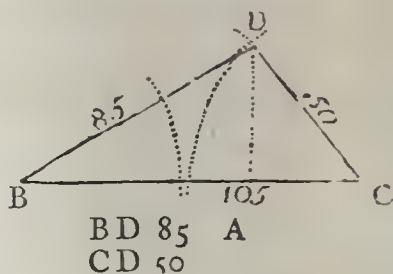
'The Triangle being thus cut becomes two Right-angled Triangles, the Hypotenuses and Bases of which are given to find the Angles by AXIOM I*.

CASE VI.

Three Sides given, to find the Angles.

The Side BC 105, BD 85, and CD 50 Miles given, to find the Angles BDC, BCD, or C B D.

The Construction is the same as Problem XIII. in Geometry.



The Sum of the two shortest Sides

The Difference of the two shortest Sides.

$$\begin{array}{r} BD \ 85 \quad A \\ CD \ 50 \\ \hline 135 \\ \hline 35 \end{array}$$

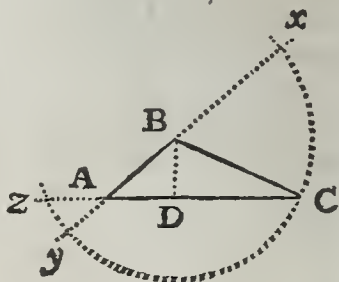
The Proportion by AXIOM IV. will be,

As the Side BC	105	2 02 119	52½ the Half of gr. Side
Is to the Sum of the Sides BD, & DC	135	2 13 033	22½ half Dif. of the Seg.
So is the Diff. of the Sides BD, & DC	35	1 54 437	75 the greatest Segm.
		3 67 440	30 lesser Segment.
		2 02 119	

Diff. of the Seg. of the Base or gr. Side 45 1 65 321

* From the Angle B in the Triangle ABC let fall the perpendicular BD; on B, as a Center with the greater Leg BC, as a Radius describe the Circle BXCZY, and produce AB to X and Y, and CA to Z. Then (by 35. 3. Euclid,) $AY \times AX = AZ \times AC$; viz.: $BC - BA : x : BC + BA : AC - DA$:

Therefore $A : C + BA :: BC - BA : DC - DA$; otherwise let the Difference of the Squares of the Sides BC and AB be taken and divided by the Base AC, the Quotient shall be the Difference of the Segments of the Base aforesaid.



OBLIQUE TRIGONOMETRY. 37

The Triangle being thus divided; becomes two Right-angled Triangles, the Hypothenufe and Bafe of which are given to find the Angles by AXIOM I. as follow :

As the Hypothenufe B D	—	85	1.92942		90° 0'
Is to Radius	—		10.00000		61 56
So is the greateft Segment		75	1.87506		
			<u>11.87506</u>	leaves Angle B	28 4
			1.92942		90 0
			<u>36 53</u>		
To Sine Angle B D A	—	61° 56'	9.94564		
			<u>11.47712</u>	leaves Angle C	53 7
As the Hypothenufe D C		50	1.69897	Co. ∠ B D A	28 4
Is to Radius	—		10.00000	Com. ∠ A D C	53 7
So is the leffer Segment A C		30	1.47712		
			<u>11.47712</u>	Sum	81 11
			1.69897		180 0
			<u>81 11</u>	Sum	81 11
To the Sine Angle A D C		36° 53'	9.77815		
			<u>98 49</u>	Ang. B D C	98 49

BY G U N T E R.

1st. 'The Extent from 105 to 135, will reach from 35 to 45 on the Line of *Numbers*.'

2dly. 'The Extent from 85 to 75 on the Line of *Numbers*, will reach from Radius to 61° 56', the Angle B D A on the Line of *Sines*.'

3dly. 'The Extent from 50 to 30 on the Line of *Numbers*, will reach from Radius to Angle A D C 36° 53' on the Line of *Sines*.'

A N
I N T R O D U C T I O N
T O T H E A R T O F
N A V I G A T I O N.

BEFORE we begin Navigation, it may not be improper to give the Learner some Idea of the System of the Universe, commonly called the *Solar*, or *Copernican System*, which is as follows:

The *Sun*, that immense and amazing Globe of Fire, the Fountain of Heat and Light of the whole System, is placed near the common Center of the Orbits of six opaque Spherical Bodies, which make their Revolutions round it in less or more Time, according to their Distance from it.

Mercury is nearest to the Sun, and receives its Light and Heat from it, and revolves round it in an Ellipsis in two Months and twenty-eight Days.

Venus is somewhat higher in the System, and describes its Ellipsis round the Sun in 7 Months and 15 Days, and becomes our Evening and Morning Star by turns.

The *Earth* is next to Venus, and describes an Ellipsis round the Sun in $365\frac{1}{4}$ Days, or One Year, which being at a greater Distance from the Sun than the former Planets, and therefore receiving less of its Light and Heat, to make up the Deficiency, the wise Author of Nature has caused a secondary Planet called the Moon, to move round it in 27 Days, 12 Hours, and 44 Minutes; it receives its Light and Heat from the Sun, and reflects it upon the Earth, which in some Measure compensates for the Absence of the Sun in the Winter Seasons in the North and South.

Mars is still higher in the System, and takes a larger Circuit, revolving round the Sun in 1 Year, 10 Months, and 22 Days.

Jupiter is the largest of all the Planets, and describes a large Ellipsis round the Sun in 11 Years, 10 Months, 27 Days, and has four Satellites or Moons moving round him, whose Light they receive from the Sun, and reflect it upon him as the Moon does upon the Earth.

Saturn is the most remote of all the Planets, revolving round the Sun in $29\frac{1}{2}$ Years, has 5 Moons which move round him, and is also surrounded with a prodigious Ring or Atmosphere.

The *Fixed Stars* are supposed to be of the same Matter with the Sun, and made for the same Ends; each of them, the Center of its own proper System, having Planets moving round it as our Sun has.

Comets are a Sort of Planets moving round the Sun in Ellipse so very oblong, that their visible Parts seem to be in a manner Parabolical; but have such vast Atmospheres about them, and Tails derived from the same, especially when they come near the Sun, as imply them designed for very different Purposes from the other Planets.

Having given a cursory View of the System of the Universe, we shall now consider the Earth a little more particularly; a perfect Knowledge of the Figure and Motion of which, with the various real and imaginary Lines upon it, is absolutely necessary in the Art of Navigation.

The *Land* and *Water* of this Earth or Planet upon which we live, make a Composition of a Spherical Form, or rather an Oblate Figure, called the Terraqueous Globe, which turns once round its Axis in 24 Hours, from West to East, and, thereby, causing all the Heavenly Bodies to revolve apparently from East to West in the same Time, making the Vicissitudes of Day and Night; and this Earth, together with its Moon moves round the Sun in 1 Year, or 365 Days 6 Hours nearly, producing the Seasons of the Year, *Winter, Summer, Autumn, and Spring.*

That the Earth is round or nearly so, will appear, not only from the Circular Shadow it has upon the Moon when that Body happens to be eclipsed by it, but also from the very Appearance of the Sea; and the many Observations made by Persons standing upon the Shore, and viewing a Ship departing from the Port; they first lose sight of the Bottom of the Vessel, whilst they can still see the Rigging and Flags at the Top; but as the ship recedes farther, they lose sight of those also, as if the Whole were sunk into the Deep. Likewise in a Ship making to Land the Mariners first descry the Tops of Steeples, Trees, &c. pointing above the Water; next, they see the Buildings themselves; and lastly, the Shore, which can only be the Effects of the Earth's Rotundity.

Its being a Globe, is also confirmed by the many Voyages which have been made round it, from East to West: First, by Magellan's Ship in the Years 1519, 1520, 1521, in 1124 Days; by Sir Francis Drake, in the Years 1577, 1578, 1579, 1580, in 1056 Days; and by the late Lord Anson, who, on the 15th of *June*, 1774, finished his long voyage of near 4 Years.

The little Unevennesses of the Earth's Surface, arising from the Hills and Vales, is no material Objection to its being considered as round; since the highest Hill or Mountain bears not so great a Proportion to the Bulk of the Earth itself, as the little risings upon the Coat of an Orange, bears to the Bigness of that Fruit.

In order to describe the Position of Places, Geographers have found it necessary to imagine certain Circles drawn upon the Surface of the Earth, to which they have given the Names of *Equator, Meridian, Horizon, Parallels of Latitude, &c.*

I. The Axis is a straight Line, imagined to pass through the Center of the Earth; the extreme Points are the Poles, on which the Earth is supposed to move, one called the *Arctic*, or *North Pole*, the other the *Antartic*, or *South Pole*.

II. The Equator is a great Circle under the Equinoctial Line in the Heavens, compassing the Earth in the Middle, between the two Poles, and divides it into two Equal Parts, called the Northern and Southern Hemispheres: From it the Latitude of Places is reckoned either North or South; and on it is counted the Degrees of Longitude from East to West. This Circle is called *Equator*, because when the Sun comes to it, which is twice a Year, viz. about the 21st of *March*, at his Entrance into Aries, and again into *Libra* about the 23d of *September*, then making equal Day and Night throughout the World.

III. The Meridians are Circles which pass through the Poles of the Earth, the Zenith and Nadir; crossing the Equator at Right Angles, and divides the Earth into two equal Parts, one East and the other West; and is so called, because, when the Sun comes to the Meridian of any Place, it is then Noon or Mid-day. They are infinite in Number; for all Places from East to West have their several Meridians; of these one is called the *first* or *chief Meridian*, from which the Longitude of Places is reckoned; it is of special Note and Use, but variously placed by Geographers, some placing it at *London*, others at *Paris*, *Teneriff*, &c. and is divided into twice 90 Degrees, numbered from the Equator towards each Pole ending in 90 Degrees. And since the Earth turns once round its Axis in 24 Hours, every Point upon its Surface describing a Circle of 360 Degrees in that Time, therefore any Place lying 15 Degrees to the East of us, has the Sun upon its Meridian one Hour sooner; or it is twelve o'Clock with the Easternmost, when it is eleven with us; and any Place 15 Degrees to the Westward of us, has the Sun one Hour after us.

IV. *Latitude* is the nearest Distance of any Place from the Equator, it is measured on an Arch of the Meridian intercepted between the Place and the Equator, and therefore can never exceed 90 Degrees. It takes its Name according as the Place is situated, either North or South of the Equator; therefore all Places that lie at the same Distance from, and on the same Side of the Equator, are said to be under the same Parallel of Latitude. Whence it follows, that if a Ship sails from a North Latitude directly North, or in a South Latitude directly South, she increases her Latitude equal to the Distance sailed; and if a Ship sails in North Latitude Southerly, or in South Latitude Northerly, she decreases her Latitude, because she sails nearer to the Equator; from whence the Latitude is counted upon the Meridian: But if a Ship sails from a South Latitude into a Northerly one, or from a North Latitude into a Southerly one, from the Difference of Latitude subtract the Latitude left,
and

and the Remainder will be the Latitude come to ; and of a different Name with the Latitude left.

Parallels of Latitude are Circles Parallel to the Equator.

The Difference of Latitude is an Arch of the Meridian contained between the two *Parallels of Latitude* ; or it is the least Distance of the *Parallels of Latitude* of two Places : shewing how far one of them is to the Northward or Southward of the other, and can never exceed 180 Degrees.

V. *The Longitude* of any Place on the Earth is expressed by an Arch of the Equator, shewing the East or West Distance of the Meridian of that Place, from some fixed Meridian, where Longitude is reckoned to begin.

Difference of Longitude is an Arch of the Equator, intercepted between the Meridian of two Places, shewing how far one of them is to the Eastward or Westward of the other.

As Longitude begins at the Meridian of some Place, and is counted from thence both Eastward and Westward, till it meets at the same Meridian on the opposite Point ; therefore the Difference of Longitude can never exceed 180 Degrees.

VI. *The Horizon* is that apparent Circle which limits or bounds the View of a Spectator on the Sea, or an extended Plain ; the Eye of the Spectator being always supposed the Center of his Horizon. Every Part of this Circle is 90 Degrees from the Center of it over our Heads, which Point is called the Zenit ; and the Point of the Heavens opposite to it, or under our Feet, is called the Nadir.

When the Sun or Stars come above the Eastermost Part of the Horizon, they are said to rise ; and when they descend the Western Part, they are said to set.

When a Ship is under the Equator both the Poles appear in the Horizon, and in Proportion as she sails towards either, or increases her Latitude, that Pole is seen proportionally above the Horizon, and the other disappears as much ; but when a ship is sailing towards the Equator, or decreases her Latitude, she depresses the elevated Pole ; that is, its Distance from the Horizon decreases : consequently the Latitude of a Place is always equal to the Elevation Pole above the Horizon.

This Circle is represented by the Mariners Compass, divided into 32 Points or Rhumbs, each $11^{\circ} 15'$.

The Tropics are two Circles parallel to the Equator, and distant from it 23 Degrees 29 Minutes ; that on the North Side of it is called the *Tropic of Cancer* : at which the Sun has its greatest North Declination ; then making to us, and all Places in North Latitude, the longest Day and shortest Night, which is about the 21st of June. The other on the South Side is called the *Tropic of Capricorn*, at which the Sun has its greatest South Declination, making then our shortest Day and longest Night ; which is about the 22d of December.

The *Polar Circles* are also parallel to the Equator, compassing the Poles of the World at 23 Degrees 29 Minutes Distance; that about the North Pole is called the *Arctic Circle*, and the other is called the *Antarctic Circle*.

These Tropics and Polar Circles divide the Globe of the Earth into 5 Parts called *Zones*, of which 3 were accounted by the Ancients to be so intemperate, as to be uninhabitable; the *Zones* are called *Torrid*, *Frigid*, and *Temperate*; that is, 1 *Torrid*, or Burning Zone, 2 *Temperate*, and 2 *Frigid*, or Frozen Zones.

The *Torrid Zone* is all that Space of the Earth and Sea which lies between the Tropics of Cancer and Capricorn, and is 47 Degrees broad; its Inhabitants see the Shadow of the Sun turn sometimes towards one Pole and sometimes towards the other.

The *Two Temperate Zones* are those Spaces of the Earth and Sea contained between each Tropic and the Polar Circles; the Inhabitants of the North Temperate Zone have their Shadows at Noon fall North, and those of the South Temperate Zone have their Shadows at Noon fall South.

The *Two Frigid Zones* are contained between each Polar Circle and its Pole; those who inhabit them have their Shadow always turning round them, according to the different Motions of the Sun.

Climates are those Tracts of the Earth bounded by imaginary Lines running parallel to the Equator, and of such a Breadth from South to North, that the Length of the Artificial Day in one, surpasses that in the other by half an Hour.

The Inhabitants of the Earth are distinguished by the several Meridians and Parallels under which they live, and are denominated either *Periæci*, *Antiæci*, or *Antipodes*.

The *Periæci* are those People of the Earth who live under the same Parallels, but opposite Meridians.

The *Antiæci* are those People of the Earth who live under the same Meridians, but opposite Parallels.

The *Antipodes* are situated directly opposite to each other, the Feet of the one directly against the Feet of the other, lying under opposite Parallels and opposite Meridians. It is Midnight with one when it is Noon Day with the other; the longest Day with the one is the shortest with the other; the Length of the Day with the one is equal to the other's Night; and the Seasons are opposite, being Summer with the one when it is Winter with the other.

The *Real Parts* are Earth and Water in general, divided into four Parts or Quarters, called *Europe*, *Asia*, *Africa*, and *America*; each of these, and consequently the whole Globe, is divided into Continents, Islands, Seas, &c.

A *Continent* is a great Quantity of Land not divided by the Sea, wherein are several Empires, Kingdoms, and Countries conjoined, as *Europe*, *Asia*, and *Africa* is one Continent, and *America* another.

An *Island* is a Part of the Earth that is environed or encompassed round by the Sea, as *Great Britain* and *Ireland*.

A *Peninsula* is a Part of Land almost surrounded with Water, save one narrow Neck of Land which joins the same to the Continent.

An *Isthmus* is a narrow Neck of Land joining the Peninsula to the Continent, by which People may pass from one to the other.

A *Promontory* is a high Part of Land stretching itself into the Sea, the Extremity of which is called a Cape or Headland.

A *Mountain* is a rising Part of dry Land over-topping the adjacent Country, and appearing first at a Distance.

The Earth being encompassed with Water, whose Washings in surrounding the dry Land cut and shape many winding Bays, Creeks, and meandering Inlets, and extending itself round them all, is but one continued Ocean.

An *Ocean* is a vast Collection of Salt Water, separating Continents from one another, and washing their Borders or Shores.

A *Sea* is Part of the Ocean to which we must sail through some Strait, as the *Mediterranean* and *Baltic Seas*.

A *Strait* is a narrow Part of the Ocean, lying between two Shores, and opening a way into some Sea, as the Straits of *Gibraltar* that lead into the Mediterranean Sea, and the *Sound*, which leads into the Baltic Sea.

A *Creek* is a small narrow Part of the Sea or River, that goes up but a little Way into the Land.

A *Bay* is a great Inlet of the Land, as the *Bay of Biscay* and the *Bay of Mexico*; otherwise a Bay is a Station or Road for Ships to anchor in.

A *River* is a considerable Stream of Water issuing out of one or various Springs, and continually gliding along in one or more Channels, till it discharges itself into the Ocean: The lesser Streams are called *Rivulets*.

A *Lake* is that which continually retains and keeps Water in it, as the *Lake Zair*, in *Africa*, and *Nicaragua*, in *America*.

A *Gulph* is a Part of the Ocean, or Sea, contained between two Shores, and is every where environed by Land except its Entrance, where it communicates with other Bays, Seas, or Oceans.

There are five Oceans, namely, the *Northern*, the *Atlantic*, the *Pacific*, the *Indian*, and the *Southern*.

The *Atlantic Ocean* is usually divided into two Parts, one called the *North Atlantic Ocean*, and the other the *South Atlantic* or *Ethiopic Ocean*.

The *Northern Ocean* stretches to the Northward of *Europe*, *Asia*, and *America*, towards the North Pole.

The *Atlantic Ocean* lies between the Continents of *Europe* and *Africa* on the East, and *America* on the West.

That Part of the North Atlantic Ocean lying between *Europe* and *America*, is frequently called the *Western Ocean*.

The *Pacific Ocean*, or as it is sometimes called, the *South Sea*, is bounded by the Western and North-west Shores of *America*, and by the Eastern and North-east shores of *Asia*.

The *Indian Ocean* washes the Shores of the Eastern Coasts of *Africa*, and the South of *Asia*, and is bounded on the East by the *Indian Islands* and the Southern Continent.

The *Southern Ocean* extends to the Southward of *Africa* and *America* towards the South Pole.

N A V I G A T I O N.

THE great End and Business of NAVIGATION is to instruct the Mariner how to conduct a Ship through the wide and pathless Ocean, to the remotest Parts of the World, the safest and shortest Way, in Passages navigable.

For the due and regular Performance of which are requisite— a perfect Knowledge of the Figure and Motion of the Earth, the various, real, and imaginary Lines upon it, so as to be able to ascertain the real Distance and Situation of Places with respect to one another, with the Use of the several Instruments made use of in measuring the Ship's Way; such as the Log, Half-minute Glass, Quadrant, to take the Altitude of the Sun and Stars; Compass, to represent the sensible Horizon; and Azimuth Compass, to take the Azimuth or Amplitude of the Sun, in order to know the Variation of the magnetic Needle; Maps or Charts of the Seas and Lands, together with the Depth of Water, and the Times and Settings of the Tides upon the Coasts he may have occasion to approach near; a competent Knowledge of Currents; of the Mould and Trim of the Ship, and the Sail she bears, that so due Allowance may be made for Lee-way: By Help of these, and Skill in the Navigator, he may know at all Times the Place the Ship is in, which Way he must steer, and how far, to gain his intended Port.

Notwithstanding what has been said, it may not be improper here to observe, that,

As Latitude is counted from the Equator upon an Arch of the Meridian, North and South, the Difference of Latitude between two Places, both North or both South, is found by subtracting the lesser Latitude from the greater; but if one Latitude be North and the other South, the Difference is found by adding both Latitudes together.

Consequently, if a Ship in North Latitude sails Northerly, or in South Latitude Southerly, she increaseth her Latitude; but in

North

North Latitude failing Southerly, or in South Latitude failing Northerly, she decreaseth her Latitude; because she fails nearer to the Equator, from whence the Latitude is reckoned.

Wherefore in North Latitude failing Northerly, or in South Latitude failing Southerly, the Difference of Latitude added to the Latitude left, gives the Latitude in.

In North Latitude failing Southerly, or in South Latitude failing Northerly, the Difference of Latitude subtracted from the Latitude left, gives the Latitude in.

When the Latitude decreases, and the Difference of Latitude is greater than the Latitude failed from, subtract the Latitude left from the Difference, and the Remainder will be the Latitude in, and of a different Name; for it is plain in this Case that the Ship has crossed the Equator.

As the *Longitude* is counted from the first Meridian East and West, until it comes to the opposite Meridian, and therefore it cannot exceed 180 Degrees.

The Difference of Longitude between two Places, being both East or West, is found by subtracting the lesser Longitude from the greater; but if one be in East Longitude and the other in West, their Sum is the Difference of Longitude.

Therefore in East Longitude failing Easterly, or in West Longitude failing Westerly, the Difference of Longitude added to the Longitude left, gives the Longitude in.

In East Longitude failing Westerly, or in West Longitude failing Easterly, the Difference of Longitude subtracted from the Longitude left, gives the Longitude in.

When a Ship fails East or West until she passes the opposite Meridian or 180 Degrees, she changes her Longitude, or comes into a Longitude of a different Name.

What has been said will be rendered familiar to the Learner by the following Examples.

EXAMP. I. What is the Difference of Latitude between London in Latitude $50^{\circ} 32' N$ and Rome in Latitude $41^{\circ} 54' N$.

From London's Lat.	51	:	32	N.
Subtract Rome's Lat.	41	:	54	N.
Rem. the Diff. of Lat.	9	:	38	
	60			
Diff. in Miles	—	578		

EXAMP. II. A Ship from Latitude $29^{\circ} 17' S$. fails Southward until her Difference of Latitude be 374 Miles, what Latitude is she come to?

Lat. failed from	29	:	17	S.
Diff of Lat. $374 \div 60$	6	:	14	S.
Lat. in	—	—	35	:
			31	S.

EXAMP.

EXAMP. III. Required the Difference of Latitude between Cape Finesterre and Cape Rogue?

Cape Finesterre's Lat.	43 : 12 N.
Cape Rogue's Lat.	5 : 00 S.
Diff. of Lat.	48 : 12 60
Diff. in Miles	2892

EXAMP. IV. A Ship from Latitude $8^{\circ} 25' N.$ sails South 600 Miles, what Latitude is she in?

From Diff of Lat. 600 Miles, or	10 : 00 S.
Sub. Lat. left	8 : 25 N.
Diff. Lat. in	1 : 35 S.

In the last Example it is plain, that as the Difference of Latitude is more than the Latitude left, the Ship must have crossed the Equator, and consequently come into South Latitude. NOTE: When one of the Places has no Latitude, or is on the Equator, then the Latitude of the other Place is their Difference of Latitude.

EXAMP. V. What is the Difference of Longitude between Cape Finesterre and Antigua?

Cape Finesterre's Long.	9 : 40 W.
Antigua's Long.	61 : 45 W.
Diff. of Long.	52 : 5 60

Diff. of Long. in Miles 3125

EXAMP. VI. A Ship from Cape Charles in Virginia sails Westward till her Difference of Longitude be 400 Miles, what Longitude is she in?

Cape Charles Long.	76 : 7 W.
Diff. of L. 400 Miles =	6 : 40 W.
Long. in	82 : 47 W.

EXAMP. VII. What is the Difference of Longitude between Barcelona and the Rock of Lisbon?

Barcelona's Long.	2 : 18 E.
Rock of Lisbon Long.	9 : 50 W.
Diff. of Long.	12 : 8

EXAMP. VIII. A Ship from $15^{\circ} 40' E.$ Longitude sails Westward till her Difference of Longitude be $27^{\circ} 15'$, what Longitude is she in?

Long. left	15 : 40 E.
Diff. of Long.	27 : 15 W.
Long. in	11 : 35 W.

EXAMP. IX. What is the Difference of Longitude between the S. E. Point of Japan and St. Christophers?

S. E. Point of Japan's L.	140 : 30 E.
St. Christ. Long.	62 : 40 W.

Exceeds $180^{\circ} 00'$	203 : 10 360 : 00
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Diff. of Long. 156 : 50

EXAMP. X. A Ship from Longitude $160^{\circ} 20' W.$ sails Westward until she differs her Longitude $41^{\circ} 20'$, what Longitude is she in?

Long. left	160 : 20 W.
Diff. of Long.	41 : 20 W.
	201 : 40 360 : 00
Long. in	158 : 20

Here it is plain that the Ship has crossed the opposite Meridian, and therefore has come into a Longitude of a different Name.

In failing due North or South, the Ship changes her Latitude only; and failing East or West her Longitude; but failing upon any other Courfe, she must change both Latitude and Longitude.

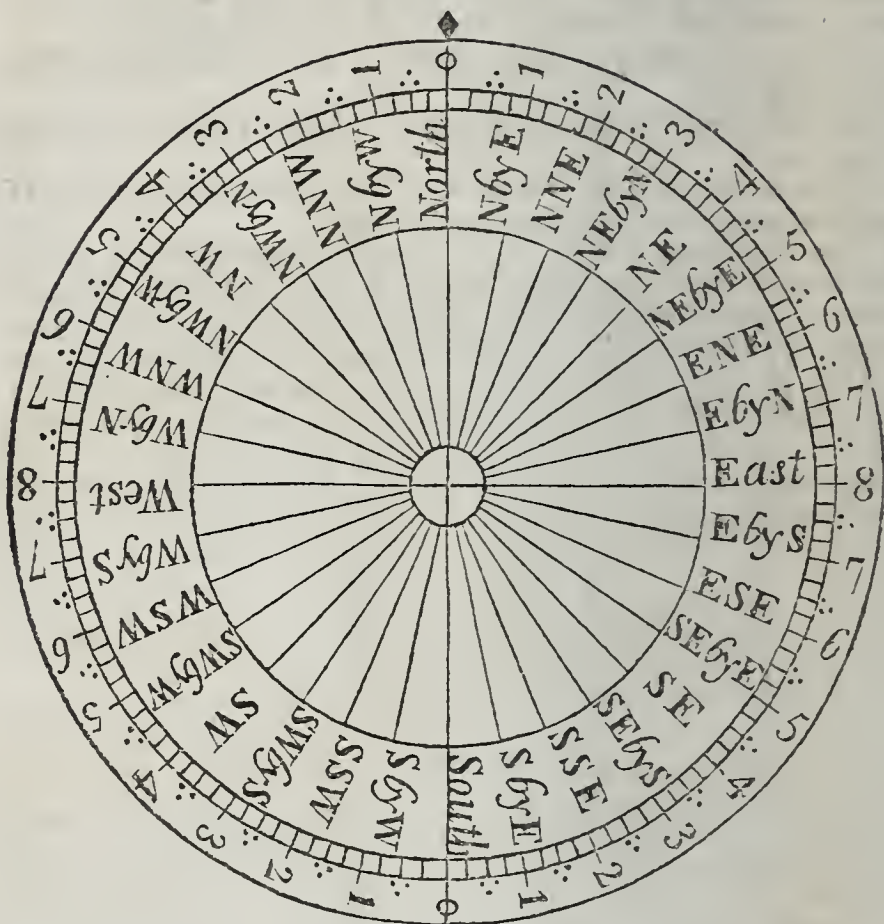
Easting or Westing in Plain Sailing is called Departure or Meridian Distance.

The Instrument used in measuring a Ship's Way at Sea, is the Log.

Ships at Sea are directed from one Place to another by means of an Instrument called the Mariner's Compass.

The *Mariner's Compass* is an Artificial Representation of the Horizon of every Place by the Means of a Circular Piece of Paper, called a Card, divided like the Horizon into Degrees and Points, which are called Rhumbs. Now the Card being properly fixed to a Piece of Steel called the Needle, that has been touched with a Loadstone (whose Property is such as to cause one End of the Needle so touched, to point towards the North when turning freely on something supporting it) all the Points of the Card will be directed towards the corresponding Points of the Horizon.

The MARINER'S COMPASS.



Hence it follows that in every Place the North Point of the Card shews the Position of the Meridian at that Place, and some one Rhumb or Point of the Card will coincide with, or be directed along the Track that makes any given Angle with the Meridian: consequently, by the Help of the Card or Compass, a Ship may be kept in any proposed Track or Course.

A *Rhumb Line* is a Right Line drawn from the Center of the Compass to the Horizon, and is named from that Point of the Horizon it falls in with.

The *Course* is the Angle which any Rhumb Line makes with the Meridian, and is sometimes reckoned in Degrees, and sometimes in Points of the Compass; so that if a Ship sails upon the second Rhumb, or N. N. E. the Course is 22 Degrees 30 Minutes: And so for any other, as in the following Table, which the Learner should be so well acquainted with, or the Compass, as to be able readily to tell how many Points any Courses or Rhumbs are distant from the Meridian, or from the Parallel.

A Table of the Angles which every $\frac{1}{4}$ Point of the Compass makes with the Meridian.

North.	South.	Points.	D. M.	North.	South.
		$\frac{1}{4}$	2.49		
		$\frac{1}{2}$	5.37		
		$\frac{3}{4}$	8.26		
N. by E.	S. by E.	1	11.15	N. by W.	S. by W.
		$\frac{1}{4}$	14. 4		
		$\frac{1}{2}$	16.52		
		$\frac{3}{4}$	19.41		
N. N. E.	S. S. E.	2	22.30	N. N. W.	S. S. W.
		$\frac{1}{4}$	25.19		
		$\frac{1}{2}$	28. 7		
		$\frac{3}{4}$	30.56		
N.E.by N	S E. by S.	3	33.45	N.W. by N.	S.W.by S.
		$\frac{1}{4}$	36.34		
		$\frac{1}{2}$	39.22		
		$\frac{3}{4}$	42.11		
N. E.	S. E.	4	45	N. W.	S. W.
		$\frac{1}{4}$	47.49		
		$\frac{1}{2}$	50.37		
		$\frac{3}{4}$	53.26		
N.E.by E.	S.E. by E.	5	56.15	N.W.by W.	S.Wby W
		$\frac{1}{4}$	59. 4		
		$\frac{1}{2}$	61.52		
		$\frac{3}{4}$	64.42		
E. N. E.	E. S. E.	6	67.30	W. N. W.	W. S. W.
		$\frac{1}{4}$	70.19		
		$\frac{1}{2}$	73. 7		
		$\frac{3}{4}$	75.56		
E. by N.	E. by S.	7	78.45	W. by N.	W. by S
		$\frac{1}{4}$	81.34		
		$\frac{1}{2}$	84.22		
		$\frac{3}{4}$	87.11		
	Eaft.	8	90. 0	West.	

PLANE SAILING.

PLANE SAILING, is the Art of NAVIGATING a Ship upon Principles deduced from the Notion of the Earth's being an extended Plane; and is no more than the Application of Plane Trigonometry to the Solution of the several Variations, or Cases; where the Hypothenufe, or longest Side, is always the Rhumb that the Ship sails upon.

The Perpendicular is the Difference of Latitude counted on the Meridian, and the Base the Departure: which is either Easting or Westing, counted from the Meridian.

The Angle opposite the Base is the Course, or Angle that the Ship makes with the Meridian; and the Angle opposite the Perpendicular is the Complement of the Course, which being taken together, make always eight Points or Rhumbs, which is 90 Degrees.

In constructing Figures relating to a Ship's Course, let the upper Part of the Paper, or what the Figure is drawn upon, always represent the North; the lower Part will be the South; the Right Hand East; and the Left West.

Draw the North and South Line to represent the Meridian of the Place the Ship sails from; then if the Ship's Course is to the Southward, mark the upper end of the Line for the Place sailed from; but if the Course is Northward, mark the lower End for that Place.

When the Course is Easterly, describe the Arch, and lay off the Course and Departure on the Right Hand Side of the Meridian, but when Westerly on the Left Hand Side.

When the Course is given in Degrees, the Degrees expressing it must be taken from the Line of Chords; but when in Points from the Line of Rhumbs; and is always to be laid off upon the Arch, beginning at the Meridian.

When the Course is given in Points, it may be set down with its corresponding Logarithm in Points in the Calculation, as found in the first Page of the Logarithms, without reducing it into Degrees, as it seems altogether unnecessary.

In all Cases, wherever the Complement Course is used, the Degrees or Points put down is the Course itself: yet the Logarithm belonging to the Complement of that Course is taken.

CASE I.

Course and Distance sailed given, to find the Difference of Latitude and the Departure from the Meridian.

Suppose a Ship from the Lizard in the Latitude of $49^{\circ} 57'$ North, sails S. W. by W. 496 Miles; required the Latitude come to, and her Departure from the Meridian?

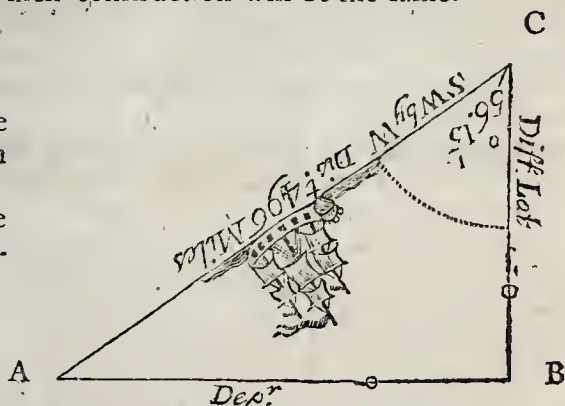
By PROJECTION.

Draw the Meridian or Difference of Latitude, with the Chord of 60° in your Compasses, and one Foot in C, describe an Arch, take $56^{\circ} 15'$ or 5 Points in your Compasses, and lay off that Distance upon the Arch from B C towards C A; through the Point where it cuts, draw the Distance C A; upon which set off 496: from A let fall the Perpendicular A B the Departure, and it is done. For A B being measured on the same Scale that A C was, will give the Departure 412.4, and B C 275.6 the Difference of Latitude.

These directions well understood, will be sufficient to instruct the Learner how to project any Case in Plane Sailing. Shall only for the future refer to the Problems of Geometry upon which they depend, and consequently their construction will be the same.

The Calculation is the same as Problem I. in TRIGONOMETRY.

I shall work this Case by making each Side Radius.



By making the Departure Radius, the Proportions will be,
The Course being 5 Points = $56^{\circ} 15'$ The Co-course is 3 Points = $33^{\circ} 45'$

As Sec. Com. Cou. 5 Pts. 10.08015	As Sec. Com. Cou. 5 Pts. 10.08015
Is to the Distance 496 2.69548	Is to the Distance 496 2.69548
So is Radius or 8 Points 10.00000	So is Tan. Co. cou. 5 Pts. 9.82489
12.69548	12.52037
10.08015	10.08015
To the Departure 412.4 2.61533	To the Diff. of Lat. 275.6 2.44022

Now as the Ship is in North Latitude sailing Southerly; from the Latitude left, 49° 57'
 Subtract the Difference of Latitude reduced into Degrees by dividing by 60, because 60 Miles make a Degree, it will make 4 35
 the Latitude come to 45 22
 And her Departure from the Meridian is 412 Miles West.

By making the Difference of Latitude Radius, it will be,

As Sec. Course	5 Pts.	10.25526	As Sec. Course	5 Pts.	10.25526
Is to the Distance	496	2.69548	Is to the Distance	496	2.69548
So is Radius		10.00000	So is Tan. Course	5 Pts.	10.17511
		<u>12.69548</u>			<u>12.87059</u>
		10.25526			10.25526
To the Diff. of Lat.	275.6	<u>2.44022</u>	To the Departure	412.4	<u>2.61533</u>

By making the Distance Radius, it will be,

As Radius		10.00000	As Radius		10.00000
Is to the Distance	496	2.69548	Is to the Distance	496	2.69548
So is Sine Course	5 Pts.	9.91985	So is S. Com. Cou.	5 Pts.	9.74474
		<u>12.61533</u>			<u>12.44022</u>
		10.00000			10.00000
To the Departure	412.4	<u>2.61533</u>	To the Diff. of Lat.	275.6	<u>2.44022</u>

Here, all the three Sides are made Radius, to find the Difference of Latitude and Departure; therefore, the Learner may make which Side Radius he pleases, but as for my Part, I shall make the last, where the Distance is made Radius, whenever the Course is given.

Though this Method of working by Logarithms is certain, yet the same may be wrought by Gunter's Scale and Compasses much more expeditious; and exact enough in the Practice of Navigation.

NOTE. When the Course is given in Points, make use of the Lines marked Sine-rhumbs, and Tangent-rhumbs on the upper Side of the Scale; when in Degrees make use of the Lines marked Sine and Tangent.

By G U N T E R.

Now to perform the last Case, extend from Radius or 8 Points, to 5 Points on the Line marked SR; that Extent will reach from the Distance 496 to the Departure 412.4 on the Line of Numbers.

2dly.

2dly. 'Extend from Radius or 8 Points to 3 Points, (the Complement of the Course) on the Line SR; that Extent will reach from the Distance 496 to the Difference of Latitude 275.6 on the Line of *Numbers*.'

Thus may all the Operations be performed in the several Cases of Navigation.

By this Case is calculated the Tables of Latitude and Departure for every Degree, Point, and Quarter Point of the Mariner's Compass to the Distance of 300 Miles, which is of excellent Use in working Days Works at Sea, and may be applied both to Middle Latitude and Mercator's Sailing, as shall be shewn hereafter; we shall only proceed now to the Working of the last Case by the Table of Difference of Latitude and Departure, which is called working.

BY INSPECTION.

Find the given Course at the Top or Bottom of the Tables, either among the Points or Degrees, and in that Page, and right against the Distance taken, in its Column, stand the Difference of Latitude and Departure in their Columns.

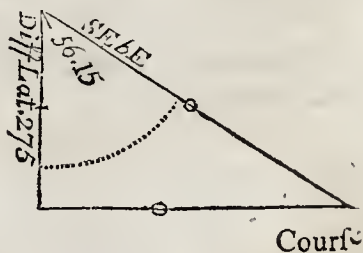
Thus the Course is S. W. by W. or 5 Points which I find at the Bottom of the Table of Difference of Latitude and Departure for Points; and as my Distance 496 is too great to be found in the Tables, I divide it by two (or any other convenient Number) and that gives 248, which I look for in the Distance Column, and right against it stands 137.8 for the Difference of Latitude, and 206.2 for the Departure, which being doubled, (because divided by 2) gives 275.6 for the Difference of Latitude, and 412.4 for the Departure, the same as before. Any of these Methods will do, but the last is chiefly practised at Sea.

CASE II.

Course and Difference of Latitude given, to find the Distance run, and Departure from the Meridian.

If a Ship runs S. E. by E. from $1^{\circ}45'$ North Latitude, and then by Observation is in $2^{\circ}50'$ South Latitude, what is her Distance and Departure?

Now in this Case as the Ship has crossed the Equator, therefore the Latitude $1^{\circ}45'$ N. added to $2^{\circ}50'$ S. is $4^{\circ}35'$, which multiplied by 60 gives 275 Miles for the Difference of Latitude.



Constructed the same as Problem VII. in Geometry.

Course S. E. by E. 5 Pts. = $56^{\circ}15'$ Complement 3 Pts. = $33^{\circ}45'$

As S. Com. Cou. 5 Points	9.74474	As S. Com. Cou. 5 Points	9.74474
Is to the Diff. of Lat. 275	2.43933	Is to the Diff. of Lat. 275	2.43933
So is S. Course 5 Points	9.91985	So is Radius	10.00000
	12.35918		12.43933
	9.74474		9.74474
To the Departure 411.6	2.61444	To the Distance 495	2.69459

Hence the Ship's Distance run is 495 Miles, and her Departure from the Meridian is 411.6 Easterly.

By G U N T E R.

'Extend from 3 Points to 5 on the Line marked S R, that Extent will reach from the Difference of Latitude 275 to the Departure 411.6 on the Line of *Numbers*.'

2dly. 'Extend from Radius or 8 Points to 3 Points, that Extent will reach from the Difference of Latitude 275 to the Distance 495 on the Line of *Numbers*.'

By I N S P E C T I O N.

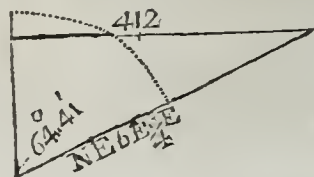
As the Difference of Latitude 275 is too great to be found in the Tables, I divide it by 5, and that gives 55, which I find over 5 Points, in the Latitude Column; against that stands 99 for the Distance, and 82.3 for the Departure, which being multiplied by 5 is 495 the Distance, and 411.5 the Departure, nearly as before.

C A S E I I I.

Course and Departure from the Meridian given, to find the Distance and Difference of Latitude.

If a Ship sails N. E. by E. $\frac{3}{4}$ E. from a Port in $3^{\circ}15'$ South Latitude, until she depart from her first Meridian 412 Miles, I demand her Distance, and what Latitude she is in?

Constructed the same as Problem VII.
in Geometry.



The

PLANE SAILING.

55

The Course $5\frac{3}{4}$ Pts. = $64^{\circ} 41'$ The Comple. $2\frac{1}{4}$ Pts. = $25^{\circ} 19'$

As S. Course $5\frac{3}{4}$ Points 9.95616
Is to the Dep. 412 2.61490
So is S. Com. Cou. $5\frac{3}{4}$ Pts. 9.63099

As S. Course	5 $\frac{3}{4}$ Points	9.95616
Is to the Dep.	412	2.61490
So is Radius		10.00000

12.24589
9.95616

12.61490
9 95616

To the Diff. of Lat. 194.8 2.28973

To the Distance 455.8 2.65874

From the Latitude left $3^{\circ} 15' \text{ S.}$
 Subtract the Difference of Latitude 195 Miles, or $3 \quad 15 \text{ N.}$

The Remaind. being nothing, shews the Ship is on the Equator. o o

BY G U N T E R.

'Extend from $5\frac{3}{4}$ Points to $2\frac{1}{4}$ on the line marked S R, that Extent will reach from the Departure 412 to the Difference of Latitude 194.8 on the Line of Numbers.'

2dly. 'Extend from Radius' to $5\frac{3}{4}$ Points, that Extent will reach from the departure 412 to the Distance 455.8 Miles.'

BY INSPECTION.

With the Course $5\frac{3}{4}$ Points, and $\frac{1}{2}$ the Departure, I find 228 for the Distance, and 97.5 for the Difference of Latitude, which being doubled, gives the Distance 456, and the Difference of Latitude 195, as before.

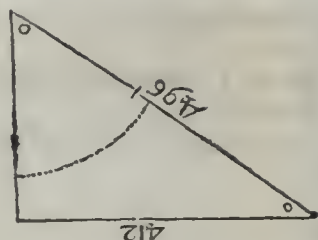
CASE IV.

Distance and Difference of Latitude given, to find the Course and Departure.

Suppose a Ship fails 496 Miles, between the South and the West, from a Port in $2^{\circ} 48'$ South Latitude, and then by Observation is in $7^{\circ} 23'$ South Latitude; what Course has she steered and what Departure has she made?

Constructed

Constructed as Problem VIII. in Geometry.



From the Latitude by Observation $7^{\circ} 23'$ take $2^{\circ} 48'$ the Latitude left, the Remainder $4^{\circ} 35'$, multiply by $60 = 275$, the Miles or Minutes of Difference of Lat.

As the Distance	496	2.69548	As Radius	10.00000
Is to Radius		10.00000	Is to the Distance	496
So is the Diff. of Lat. 275	2.43933		So is S. Course $56^{\circ} 20'$	9 92027
		12.43953		12.61575
		2.69548		10.00000

To S. Com. Course $56^{\circ} 20'$ 9.74385 To the Departure 412.8 2.61575

Hence, the Course is S. E. by E. and the Departure 412.8 Miles.

BY G U N T E R.

' The Extent from the Distance 496 to the Difference of Latitude 275 on the Line of *Numbers*, will reach from Radius or 90° to $33^{\circ} 40'$ the Co-course on the line of *Sines*.'

' And the Extent from Radius to $56^{\circ} 20'$ on the Line of *Sines*, will reach from the Distance 496 to the Departure 412.8 on the Line of *Numbers*.'

BY I N S P E C T I O N.

With $\frac{1}{2}$ the Distance 248, and $\frac{1}{2}$ the Difference of Lat. 137.5 look in the Tables till they are found to agree in their respective Columns, which they do nearly over 5 Points, against which stands 206.2 for the Departure, and being doubled, give 412.4, nearly as before.

C A S E V.

Distance and Departure given, to find the Course and Difference of Latitude.

Admit a ship sails 496 Minutes between the North and West from the Island *Bermudas* in Latitude $32^{\circ} 25'$ North, until her Departure is 412 Miles, what Course has she steered, and what Latitude is she in?

As

As the Distance	496	2.69548	As Radius	10 00000
Is to Radius		10.00000	Is to the Distance	496
So is Departure	412	2.61490	So is the S.Com.Co.	$56^{\circ} 10'$
		12.61490		9.74568
		2.69548		12.44116
				10.00000
To the S. of Course	$56^{\circ} 10'$	9.91942	To the Diff. of Lat.	276.1
				2.44116

Hence the Course is N. $56^{\circ} 10'$ W. or N. W. by W.

To the Latitude failed from $32^{\circ} 25'$ add the Difference of Latitude 276, or $4^{\circ} 36'$, gives $37^{\circ} 1'$, the Latitude the Ship is in.

BY G U N T E R.

' Extend from the Distance 496 to the Departure 412 on the Line of *Numbers*, that Extent will reach from Radius to the Course $56^{\circ} 10'$ on the Line of *Sines*.'

' 2dly. Extend from Radius to the Complement of the Course $33^{\circ} 50'$ on the Line of *Sines*, that Extent will reach from the Distance 496 to the Difference of Latitude 276 on the Line of *Num*.'

BY I N S P E C T I O N.

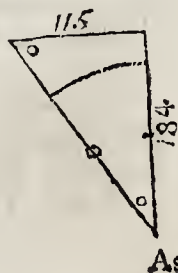
With $\frac{1}{2}$ the distance 248, and $\frac{1}{2}$ the Departure 206, I look in the Tables, and find them to agree in their Columns nearly over 5 Points, against which is Latitude 137.8 , which being doubled, is 275.6, the Difference of Latitude, nearly as before.

C A S E VI.

Difference of Latitude and Departure given, to find the Course, and Distance.

A Ship sails between the North and West till her Difference of Latitude is 184 Miles, and her Departure is 115 Miles, I demand her Course and Distance?

Constructed as Problem IX. in Geometry.



As the Diff. of Lat. 184	2.26482	As Radius	10.00000
Is to Radius	10.00000	Is to the Diff. of Lat. 184	2.26482
So is the Departure 115	2.06070	So is Sec. of the Cou. 32°	10.07158
	12.06070		12.33640
	2 26482		10.00000
To the Tan. of the Cou. 32°	9.79588	To the Distance 217	2.33640

Hence her Course is North 32° Westerly, and Distance sailed 217 Miles.

By G U N T E R.

‘ Extend from the Difference of Latitude 184 to the Departure 115 on the Line of *Numbers*, that Extent will reach from Radius or 45° to the Course 32° on the Line of *Tangents*.

2dly. ‘ For the Distance we must consider it as Radius (there being no Line of *Secants* on the Scale) and extend from Radius or 90° to the Course 32° on the Line of *Sines*, that Extent will reach from the Departure 115, to the Distance 217 on the Line of *Numbers*.’

By I N S P E C T I O N.

Seek in the Tables till the given Difference of Latitude 184 and Departure 115 are found together in their respective Columns; then right against them will be found the Distance 217 in its Column, and the Course stands among the Degrees at the Top or Bottom of the Column where the Difference of Latitude and Departure were found; which in this Case is under 32°, the Course required.

The six foregoing Problems are the common Cases of Plane Sailing, which the Learner ought to be well acquainted with; and for that End, I here add six more for Practice, whose Answers may be found by the foregoing Rules.

Question I. A Ship in 2° 10' South Latitude, sails N. by E. 89 Leagues, what Latitude is she in, and what is her Departure?

Answer. Latitude in 2° 12' North, and Departure 17.36. Leagues.

Question II. A Ship sails S. S. W. from a Port in 41° 30' North Latitude, and then by Observation the said Ship is in 36° 57' North Latitude, I demand the Distance run, and Departure?

Answer. Distance run 98.5 Leagues, Departure 37.7 Leagues.

Question.

Question III. A Ship fails S. S. W. $\frac{1}{2}$ W. from $2^{\circ} 30'$ South Latitude, until the Departure be 59 Leagues, I demand her Distance run, and Latitude in?

Answer. Distance run 125.2 Leagues, Latitude in $8^{\circ} 1'$ South.

Question IV. If a Ship fails 360 Miles South Westward from $21^{\circ} 59'$ South Latitude, until by Observation she be in $24^{\circ} 49'$ South Latitude, what is her Course and Departure?

Answer. Course is S. W. by W. $\frac{1}{2}$ W. and Departure from the Meridian is 317.3 Miles.

Question V. Suppose a Ship fails 354 Miles North Eastward from $2^{\circ} 9'$ South Latitude, until her Departure be 150 Miles, what is her Course and Latitude in?

Answer. Course is N. N. E. $\frac{1}{4}$ E. nearest, and Latitude the Ship is in is $3^{\circ} 12'$ North.

Question VI. Sailing between the North and the West from a Port in $1^{\circ} 59'$ South Latitude, and then arriving at another Port in $4^{\circ} 8'$ North Latitude, which is 209 Miles to the Westward of the first Port, I demand the Course and Distance from the first Port to the second?

Answer. Course is N. N. W. $\frac{1}{2}$ W. and Distance of the Ports is 422.3 Miles, or 140.7 Leagues.

TRAVERSE SAILING.

HAVING learned these necessary Problems, concerning a Single Course, the next is a Compound Course, commonly called a TRAVERSE; in order to the right understanding of which, observe the following Definitions.

A *Traverse* is when a Ship, meeting with contrary Winds, fails on several Courses.

When the Wind is directly or partly against a Ship's direct Course to the Place she is bound to, she reaches her Port by a Kind of Z like Course; which is made by failing with the Wind, first on one Side the Ship, and then on the other Side.

In a Ship looking towards the Stem or Head.

Starboard signifies the Right Hand Side.

Larboard the Left Hand Side.

Forwards or *Afore*, is towards the Head or Stem of the Ship.

Aft or *Abaft*, is towards the hinder Part or Stern.

The *Beam* signifies athwart or across the Middle of the Ship.

When a Ship fails the same Way the Wind blows, she is said to fail or run before the Wind; and the Wind is said to be right aft or right a Stern; and her Course is then 16 Points from the Wind.

When a Ship fails with the Wind blowing directly across her, she is said to have the Wind on the Beam; and her Course is 8 Points from the Wind.

When the Wind blows obliquely across the Ship, the Wind is said to be abaft the Beam, or afore the Beam, according as her Course is more or less, than 8 Points from the Wind.

When a Ship endeavours to fail towards that Point of the Compass from whence the Wind blows, she is said to fail on a Wind, or to ply to Windward.

A Vessel failing as near as she can to the Point from whence the Wind blows, is said to be close hauled. The generality of Ships will lie within about 6 Points of the Wind, but Sloops and other Vessels will lie much nearer.

The *Windward* or *Weather Side*, is that Side of the Ship on which the Wind blows; and the other Side is called the Leeward or Lee-Side.

Tacks and *Sheets* are large Ropes made fast to the lower Corners of the *Fore* and *Main Sails*, by which either of these Corners are hauled fore and aft.

When a Ship fails on the Wind, the Windward Tacks are always hauled forwards, and the Leeward Sheets aft.

The Starboard Tacks are aboard when the Starboard Side is to the Windward, and the Larboard to the Leeward; and the Larboard Tacks are aboard when the Larboard Side is to the Windward, and the Starboard to the Leeward.

To know how near the Wind a Ship will lie: Observe the Course she goes on each Tack when she is close hauled, then Half the Number of Points between the two Courses will shew how near the Wind that Ship will lie.

The most common Cases in turning to the Windward may be constructed by the following Precepts.

Having drawn the Meridian and Parallel of Latitude (or East and West Line) in a Circle representing the Horizon of the Place, mark in the Circumference the Place of the Wind; draw the Rhumb passing through the Place bound to, and lay thereon the Distance of that Place from the Center.

On each Side of the Wind lay off in the Circumference the Points or Degrees shewing how near the Wind the Ship can lie, and draw these Rhumbs.

Now the first Course will be on one of these Rhumbs, according to the Tack the Ship leads with; draw a Line through the Place bound to, parallel to the other Point, to meet with the First, and this will shew the Course and Distance on the other Tack.

To RESOLVE a Traverse is to reduce and bring several Courses into one; the Courses are known by the Compass, and the Distance by the Log, which in common Voyages is heaved once in two Hours, but in Ships of War, or to the East Indies, every Hour.

In the Steerage or some convenient Place in the Ship, there generally hangs a Table called the Logboard, divided into seven Columns; in the first is written the Hours of the Day, the second the Knots that the Ship runs during Half a Minute, each of these Knots bears the same Proportion to a Sea Mile, that Half a Minute does to an Hour; consequently so many Knots as the Ship runs in Half a Minute, (the Time allowed for trying the Experiment) so many Miles she runs in an Hour. In the third the Fathoms, 10 of which ought to make a Knot; in the fourth the Courses steered by the Compass; in the fifth the Winds; in the sixth the Leeway, or how far the Ship is drove to the Leeward of the Course steered by the Compass; in the seventh the Transactions of the Day, as in the following Table. Every Day at Noon the Logboard is transcribed into the Logbook, which is divided into Columns exactly like the Logboard, and the several Courses being corrected for the Leeway and Variation, and the Distance or Run upon each being set down in a Traverse Table, shews what Difference of Latitude and Departure the Ship has made during the last 24 Hours, and from thence is found the Latitude and Longitude the Ship is in, &c. This Operation is called doing a Day's Work.

The LOG BOARD.

H.	K.	F.	Courses.	Winds.	Lee-way.	Transactions.
2	6		S.W by W	N.		Moderate Gales and fair Weather, at 8 A. M. saw a Ship to the Northward.
4	5	5		N. W.		
6	5					
8	5					
10	4	5	N. E.	N. N. W.		
12	4	5				
2	4	5				
4	4	5				
6	4	5				
8	5		S.W.byS	W.N. W.		
10	4	5				
12	4					

Having placed the several Courses and Distances run upon each, begin with the first Course S. W. by W. which is 5 Points, and the Distance run upon it being summed up is 21.5, or an Half, which being doubled because the Log is hove every two Hours) is 43. In like Manner proceed with the other Courses, and then find the Difference of Latitude and Departure for each Course and Distance.

When the Course is to the Southward, the Difference of Latitude must be set in the Column marked S. but if to the Northward, in that marked N. likewise when the Course is to the Eastward, the Departure must be set in the Column marked E. but if to the Westward, in that marked W. Thus the first Course being S. W. by W. 5 Points the Difference of Latitude belonging to it is set under S. and the Departure under W. as in the following Table.

The TRAVERSE TABLE.

Courses.	Dist.	N.	S.	E.	W.
S.W by W	43		35.8		23.9
N. E.	45	31.8		31.8	
S.W.byS	27		22.4		15.0
		31.8	58.2		38.9
			31.8	31.8	31.8
		Dif. Lat. S	26.4	Dep. W.	7.1

Here the Westings being greater than the Eastings, the Difference shews how far the Ship has got to the Westward; and the Southings being greater than the Northings, shew how far she has got to the Southward of the Place she set out from.

In heaving the Log, one Man holds the Reel upon which the Log-line is wound, and another holds the Half-minute Glas; an Officer of the Watch heaves the Log over the Stern on the Lee-side, and when he observes the stray Line is run off the Reel (to denote which there is fixed a Red Rag) he cries *turn!* the Glas-holder answers *done!* who, watching the Glas the Moment it is run out, cries *stop!* the Reel being immediately stopt, the Knots, or Knots and Fathoms run, shew the Ship's Rate of Sailing per Hour, if the Wind is constant.

Suppose a Ship from the Lizard in Lat. $49^{\circ} 57'$ is bound to Cork in the Latitude $51^{\circ} 49' N.$ whose Departure from the Meridian is 162 Miles West, but by Reason of contrary Winds is obliged to sail on the following Courses, viz. S. S. W. 54 Miles, W. by S. 39 Miles, N. W. by N. 40 Miles, N. E. by E. 69 Miles; N. N. W. 60 Miles; I demand the direct Course, Distance, Difference of Latitude and Departure made good upon these several Courses, with the Latitude the Ship is in, and what Course she must steer, and how far, to gain her intended Port.

B Y P R O J E C T I O N

Latitude of Cork	—	51°	$49'$	}
Latitude of Lizard	—	49	57	}

Difference of Latitude $12 = 112$ Miles, the Dep. 162 Miles.

With the Difference of Latitude 112, and Departure 162, between the Lizard and Cork by the last Case, the Course will be found nearly N. W. by W. and Distance 197 Miles.

With the Chord of 60° describe a Circle, through which draw the Meridian, North and South, and crossing that at Right Angles, draw the East and West Points. The Center represents the Lizard; then set off two Points from the South westerly, through which draw a Line to the Center for the first Course S. S. W. upon that set off the first Distance run 54 Miles, which is the Ship's Place at the End of her first Course; draw the W. by S. Rhumb, and, parallel to it, a Line passing through the Ship's last Place, and upon that set off 39 for the second Distance; draw the N. W. by N. Rhumb, and parallel to it, as before, draw a Line passing through

By the above Method any Traverse may be constructed, as also the Ship's Way pricked off on the Plane Chart.

But it being rather tedious, and not sufficiently accurate, we generally work at Sea

BY INSPECTION.

First to find the Course and Distance between the two Ports.

In the Table it will be found that the Numbers standing together nearest to 112 the Difference of Latitude, and 162 the Departure, are 161.3 and 113 over 55°; the Distance answering to these is 197, consequently the direct Course is N. 55 W. or nearly N. W. by W. Distance 197 Miles.

2dly. Begin with the first Course S. S. W. 2 Points, under which in the Tables, and opposite to the Distance 54 Miles, stands 49.9 for the Difference of Latitude, and 20.7 for the Departure; and as the Course is between the South and West, set the Difference of Latitude in the Column marked South, and the Departure in that marked West; in like Manner proceed with each Course and Distance, which being found as above, will stand as in the following Traverse Table.

The TRAVERSE TABLE.

Courses.	Distance.	Differ. of Lat.		Departure.	
		N.	S.	E.	W.
S. S. W.	54		49.9		20.7
W. by S.	39		7.6		38.2
N.W. by N.	40	33.3			22.2
N. E. by E.	69	38.3		57.4	
N. N. W.	60	55.4			23 0
		127.0	57.5	57.4	104.1
		57.5			57.4
Diff. of Lat. Northerly		69.5	Depart. Westerly		46.7

Having placed them as above, add up all the Westings, Eastings, Northings, and Southings separately, and set down their respective Sums at the Bottom of each Column; and as the Westing is greater than the Easting, subtract the one from the other, and the Difference 46.7 shews that the Ship's Departure is so much West of her first Place.

Again, the Northing being greater than the Southing, subtract the lesser from the greater, and the Remainder 69.5 shews how far the Ship is to the Northward of her first Place.

Now having the Difference of Latitude and Departure made good upon the several Courses, seek in the Tables until they are found standing together in their respective Columns, the nearest to which is 69.6 and 47. under 34 Degrees, against them stands 84 for the Distance; consequently the Course made good upon the several Courses is N. 34 W. Distance 84 Miles.

To find the direct Course and Distance to the intended Port.

To the Latitude left $49^{\circ} 57'$ N. add the Difference 69 equal $1^{\circ} 9'$ gives 51.6 the Latitude in: Then,

From the Latitude Cork	—	51.49
Subtract the Latitude in	—	51. 6

The Difference of Latitude between the Ship and Cork is 43Ms.

The Departure between the two Ports is	—	162. Ms.
The Departure made being W. subtract	—	46. 7

The Departure between the Ship and Cork is 115. 3Ms.

With this Difference of Latitude 43, and Departure 115.3, seek in the Tables till they are found standing together in their respective Columns, the nearest to which will be found over 69° , and 70° being added is 139, $\frac{1}{2}$ that Sum $69^{\circ} 30'$ is the Course, and half the Distance to these is 123.

Hence the Ship's direct Course to Cork is N. $69^{\circ} 30'$ W. and Distance 123 Miles.

The same may be done

BY CALCULATION.

To find the direct Course and Distance between the Lizard and Cork by Case VI. it will be,

As the Diff. of Lat. 112	2.04922	As the S. of Course 55.20	9 91512
Is to Radius	10.00000	Is to the Depar. 162	2.20951
So is the Departure 162	2.20951	So is Radius	10.00000
	<u>12.20951</u>		<u>12.20951</u>
	2.04922		9.91512
	<u>10.16029</u>		
To the Tan. Cou. $55^{\circ} 20'$	10.16029	To the Distance	197 2.29439

Hence the direct Course and Distance between the Lizard and Cork is N. 55.20 W. or N. W. by W. nearly, Distance 197 Miles. Then,

For the first Course S. S. W. 2 Points, Distance 54 Miles.

As Radius	10.00000	As Radius	10.00000
Is to the Distance	54	Is to the Distance	54
So is S. Course	2 Pts. 9.58285	So is S. Course	2 Pts. 9.96562
	11.31523		11.69801
	10.00000		10.00000
To the Departure	20.7	To the Diff. of Lat.	49 9
	1.31523		1.69801

In like Manner proceed to find the Difference of Latitude and Departure for the other Courses and Distances; which being found and set down in their respective Columns, will stand as in the foregoing Table.

Having found the Difference of Latitude and Departure made upon the several Courses, and also the Latitude in, with the Difference of Latitude and Departure between the Ship and Cork, as before, the direct Course by Case VI. will be found N. 69° 33' W. and Distance 123 Miles.

All the preceding may be found by Gunter's Scale, but shall leave the working of them to exercise the Learner, who ought to be well acquainted with Traverse Sailing; and for that Purpose it has been thought proper to subjoin the following, which is the most general and useful that well can be, and may be worked by any of the foregoing Methods.

A Ship being at Sea in Latitude 37° 10' N. is bound to a Port in Latitude 33° 0' N. the Departure between the Ship and the Place is 180 Miles, consequently by Case VI. the Course will be S. W. by S. 2 Degrees Westerly and Distance 308 Miles, but the Wind being variable, is obliged to ply upon these several Courses, the Distance run upon each being obtained by the Log; and first she sails (with her Larboard Tacks on Board) S. W. by W. 27 Miles, W. S. W. $\frac{1}{2}$ W. 30 Miles, W. by S. 25 Miles, W. by N. 18 Miles. (Starboard Tacks on Board Wind shifting) S. S. E. 32 Miles, S. S. E. $\frac{1}{4}$ E. 27 Miles, S. by E. 25 Miles, S. 31 Miles, S. S. E. 39 Miles.

Required the Latitude the Ship is in and her Departure from the Meridian, upon what Course she must steer if possible, and how far she must sail, to gain her intended Port.

The

The Difference of Latitude and Departure being found by the preceding Directions, will stand as in the following Table.

The Traverse Table.		Differ. of Lat		Departure.	
Courses.	Distances.	N.	S.	E.	W.
S. W. by W	27		15.0		22.4
W.S.W. $\frac{1}{2}$ W	50		8.7		28.7
W. by S.	25		4.9		24.5
W. by N.	18	3.5			17.7
S. S. E.	32		20.6	12.2	
S. S. E. $\frac{3}{4}$ E.	27		23.2	13.9	
S. by E.	25		24.5	4.9	
South.	31		31.0		
S. S. E.	39		36.0	14.9	
		3.5	172.9	45.9	93.3
			3.5		45.9
		Diff Lat. 169.4 S		Depar.	47.4 W.

The Ship is in Latitude $34^{\circ} 20' N.$ the Departure is 47.4 W.

The Course made good is S. $15^{\circ} 38' W.$ and Distance 175.9.

The Course to the intended Port is S. $58^{\circ} 41' W.$ or S. W. by W. $\frac{1}{4}$ W. nearly, Distance 155.2.

NOTE. The Teacher may put the Pupil upon MERCATOR'S SAILING immediately, if his Time be short, (which is the case with many who go to School purely to learn NAVIGATION only) without going through MIDDLE LATITUDE SAILING, as the former is fully sufficient for the Seaman's Purpose, provided he be shewn how to reduce Miles of Easting or Westing in Diff. of Longitude.

MIDDLE LATITUDE SAILING.

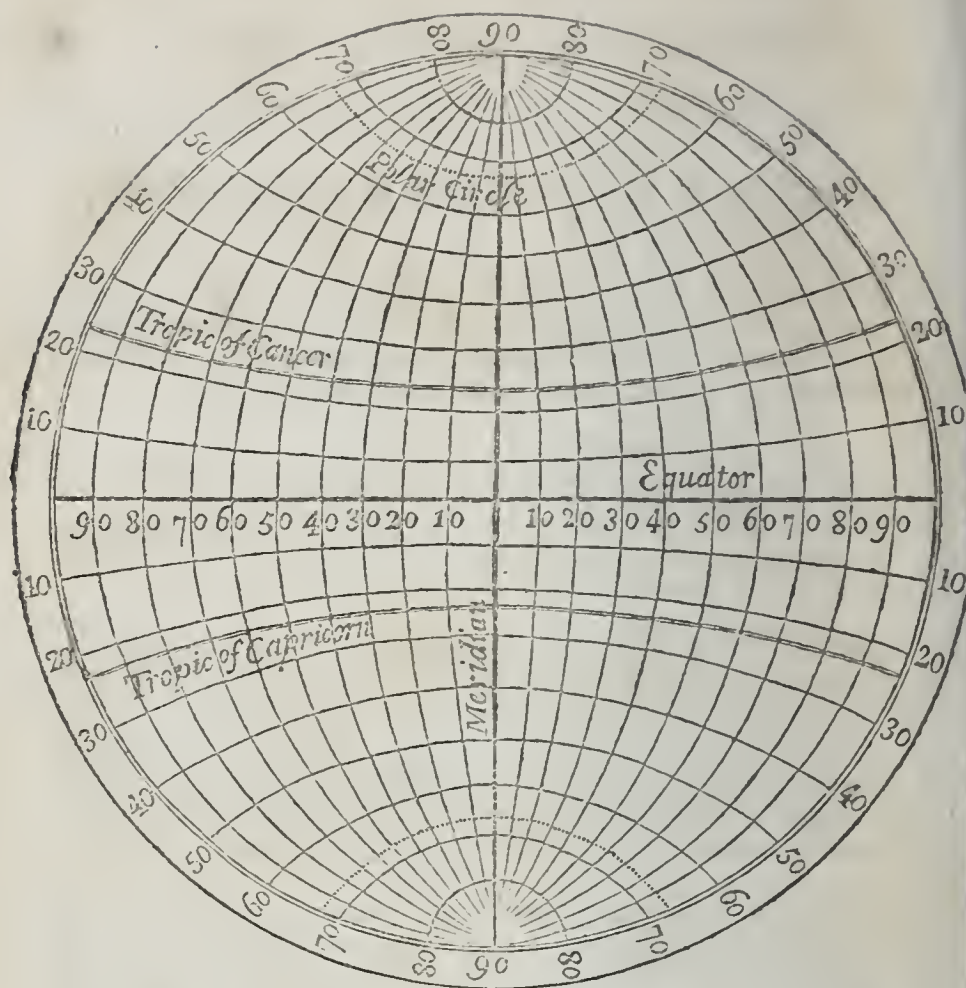
IN PLANE SAILING the Earth was considered as a Plane, representing a Bowling-Green, having the Meridians parallel to each other, and consequently the Degree of Longitude equal in all Places; but this cannot be true, as the Earth is a Globe or Sphere: for

As the Meridians are Circles on the Terraqueous Globe, meeting in the Poles, (as may be seen in the following Figure) it is obvious that any two of these Circles must recede more at greater Distances from the Poles; and at equal Distances from each Pole, or at the Equator, the Distance between the Meridians is greatest.

The true Place of a Ship at Sea depends upon its Distance from the Equator, and some noted Meridian; and since the Meridional Distance, that is the Distance between the two Meridians, varies in every Latitude, it is therefore convenient this Distance should be reckoned in a fixed Latitude; and where the Degrees are of the same Magnitude with those of the Meridian, which can be no where but on the Equator, where 60 Geographical Miles make a Degree.

The Circumference of all Circles are in direct Proportion to each other, as their Radii; and since the Earth turns once round its Axis in 24 Hours, every Point upon its Surface must describe Circles parallel to the Equator: Hence it follows, that the Circumference of any Parallel of Latitude in Miles, is to the Circumference of the Equator in Miles, as the Co-Sine of that Latitude is to Radius; and that the Breadth of a Degree in any Parallel of Latitude is to the Breadth of a Degree upon the Equator, as the Sine Complement of that of Latitude is to Radius.

By the last Proportion was the following Table calculated, which shews the Breadth of a Degree of Longitude in every Latitude; and may be made to answer for any Degrees and Minutes by taking proportional Parts.



D. L.	Miles.	D. L.	Miles.	D. L.	Miles.	D. L.	Miles.	D. L.	Miles.
1	59 99	19	56 73	37	47 92	55	34 41	73	17 54
2	59 98	20	56 58	38	47 28	56	33 55	74	16 53
3	59 92	21	56 01	39	45 62	57	32 68	75	15 52
4	59 86	22	55 65	40	45 95	58	31 79	76	14 51
5	59 77	23	55 23	41	45 28	59	30 90	77	13 50
6	59 67	24	54 81	42	44 59	60	30 00	78	12 48
7	59 56	25	54 38	43	43 88	61	29 9	79	11 45
8	59 42	26	53 93	44	43 16	62	28 17	80	10 42
9	59 26	27	53 56	45	42 43	63	27 24	81	9 38
10	59 08	28	52 97	46	41 68	64	26 30	82	8 35
11	58 89	29	52 47	47	40 92	65	25 36	83	7 32
12	58 68	30	51 96	48	40 15	66	24 41	84	6 28
13	58 46	31	51 43	49	39 36	67	23 45	85	5 23
14	58 22	32	50 88	50	38 57	68	22 48	86	4 18
15	57 95	33	50 32	51	37 76	69	20 50	87	3 14
16	57 67	34	49 74	52	36 94	70	21 52	88	2 09
17	57 37	35	49 15	53	36 11	71	19 54	89	1 05
18	57 06	36	48 54	54	35 26	72	18 55		

The above Table shews how many Miles answer to a Degree of Longitude, at every Degree of Latitude.

Hence it follows that :

As the S. Com. of any Lat.	} >	As Radius
Is to Radius		Is to S. C. of any Para. of Lat.
So is the Dist. run in that Lat. in Ms.		So is Diff. of Lon. in Miles
To the Miles or Minutes Difference of Longitude.		between any two Meridians To their Dif. in M. in that Lat.

From what has been said arises the Solution of the following Problems.

PROBLEM I.

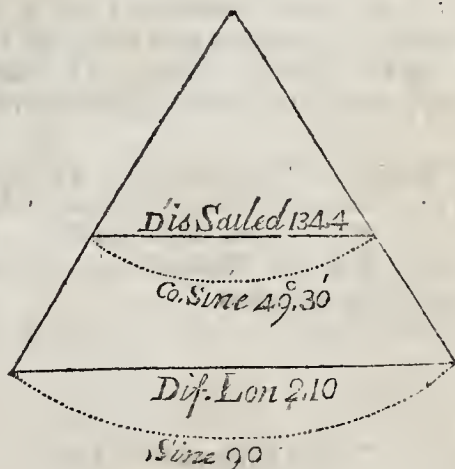
The Difference of Longitude between two Places both in one Parallel of Latitude being given, to find the Distance between them.

Suppose a Ship in the Latitude $49^{\circ} 30'$ N. or S. sails directly E. or W. until her Difference of Longitude be $3^{\circ} 30'$ and the Distance sailed be required.

BY PROJECTION.

With the Sine of 90° on the Plane Scale, describe an Arch, and upon it set off the Difference of Longitude 210 Miles (taken from some Scale of equal Parts) then describe an Arch upon the former Center with the Sine Comp. of the Latitude, and from the two Points, where the Difference of Longitude cut the first Arch, draw Lines to the Center, and they will cut the last Arch in two Points, the Distance between which being measured on the same Scale is 136.4, the Distance required.

See the Figure.



By

BY CALCULATION.

As Radius	—	—	10.00000
Is to Sine Complement of Latitude	49.30		9.81254
So is the Difference of Longitude	210		2.32222
			12.13476
			10.00000
To the Distance required	136.4		2.13476

BY GUNTER.

' The Extent from Radius to Sine Com. $49^{\circ} 30'$ on the Line of *Sines*, will reach from the Difference of Longitude 210 to the Distance 136.4 on the Line of *Numbers*.'

BY INSPECTION.

Find the Sine Com. of the Latitude among the Degrees, and in the Distance Column the Difference of Longitude; opposite to which, in the Column of Departure, is the Distance required; but as the Co-Latitude is $40^{\circ} 30'$, therefore,

For 40 Degrees you'll find	135
For 41 Degrees you'll find	137.7
The Sum is	272.7
Half is the Distance required.	136.3

This is done because the Table of Difference of Latitude and Departure is calculated only for single Degrees.

By the Reverse of the last Problem, having the Distance run in any Parallel, to find the Difference of Longitude.

Suppose a Ship in Latitude $49^{\circ} 30'$ N. or S. sails directly E. or W. 136.4 Miles, and her Difference of Longitude be required.

As S. Com. of Latitude	$49^{\circ} 30'$	9.81254
It to the Distance	136.4	2.13481
So is Radius		10.00000
		12.13481
		9.81254
To the Difference of Lon.	210	232227

P R O B L E M II.

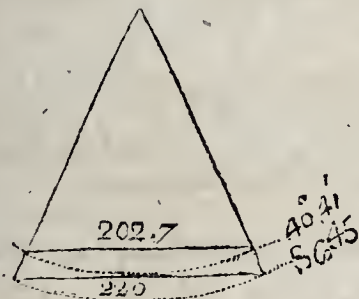
If it be required to find the Distance of two Places under the same Parallel, and the Distance of two other Places under the same Meridians with the former, differing only in Latitude, it will be,

As the Sine Complement of one Latitude, is to the Distance between two Places in that Latitude, so is the Sine Complement of any other Latitude, to the Distance between two Places in that Latitude; lying under the same Meridian with the former Places.

Suppose two Ships in the Latitude 45° N. Distance 220 Miles, sail both directly North 260 Miles, and it be required to find their Distance asunder?

B Y P R O J E C T I O N

Having reduced the Distance sailed 260 Miles into Degrees, and added then to the Latitude sailed from 45° , gives $49^{\circ} 20'$ the Latitude they are in: with the Sine Complement of the first Latitude 45° in your Compasses describe an Arch; and with the Sine Complement of the second Latitude $40^{\circ} 40'$ describe an Arch upon the former Center; then upon the first Arch set off the First Distance, and from the two Extremities draw Lines to the Center, and they will cut the second Arch in two Points; the Distance between which being measured upon the same Scale, will be 202.7, the Distance the Ships are asunder in the Latitude come to.



B Y C A L C U L A T I O N.

As the Sine Complement of the Latitude sailed from	45°	9.84948
Is to their Distance as asunder	220	2.34242
So is the Sine Complement of the Latitude come to	$49^{\circ} 20'$	9.81402
		12.15644
		9.84948

To the Distance required

202.7 2.30696

B Y G U N T E R.

' The Extent from 45° to $40^{\circ} 40'$ on the Line of *Sines*, will reach 220 to 202.7 the second Distance on the Line of *Numbers*.'

From what has been said it will be easy to conceive, that the Longitude counted in one Parallel of Latitude, will not be equal to that counted in any other Parallel of Latitude, on the same Side of the Equator; and as Ships seldom sail N. or S. upon one Meridian, but cross many in various Directions, it follows, that the Longitude can neither be found by the Latitude left, nor by that come to: therefore add them together, and take half that Sum for a Mean or Middle Latitude, by which Departure may be converted into Longitude, and Longitude into Departure; for it will be,

As the S. Com. of the Mid. Lat.	} > {	As Radius
Is to the Dep. from the Meridian		Is to the Diff. of Longitude
So is Radius		So is the S. Com. of Mid. Lat.
To the Miles of Differ. of Long.		To the Departure.

Or, without having the Departure to find the rest, it will be,

As the Diff. of Lat.		As Sine Com. Mid. Lat.
Is to the Diff. of Long.		Is to the Tangent of the Course,
So is the Sine Com. Mid. Lat.		So is the Difference of Latitude
To the Tan. of the Course.		To the Difference of Longitude.

A N D,

As the Sine Com. Middle Lat.
Is to the Sine Course,
So is the Distance sailed
To the Diff. of Longitude.

This is called *Middle Latitude Sailing*, by which many Seamen keep their reckoning at Sea, and nearly agrees with *Mercator's Sailing*.

C A S E I.

The Latitude and Longitude of two Places given, to find the Course and Distance.

What is the Course and Distance from the Lizard to the Island of Barbadoes?

Lizard

MIDDLE LATITUDE SAILING. 75

Lizard } Lat. { $49^{\circ} 57' N.$ - $49^{\circ} 57'$ } Long. { $5^{\circ} 14' West.$
 Barbadoes } { $12 58 N.$ - $12 58$ } { $58 50 W.$

Difference of Lat. $36 59$ Sum is $62 55$ Diff. of Lon. $53 36$
 60

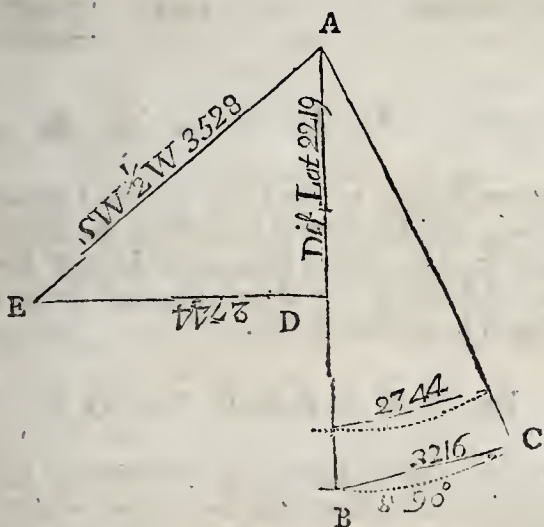
Miles or Minutes 2219 $31 27$ Miles or Min. 3216
 $90 00$

Com. Mid. Lat. $58 33$

BY PROJECTION.

First draw a Meridian, AB, and describe an Arch with the Sine of 90° , upon which set off from the Meridian the Difference of Longitude BC 3216 Miles; from the Point where that cuts the Arch at C, draw a Line to the Center.

Upon the former Center describe an Arch with the Sine Com. of Middle Latitude $58 33$, and the Distance between the two Points where it cuts the two former Lines AB and AC, will be the Departure 2744: then from the point A, set off upon the Meridian the Difference of Latitude AD = 2219, upon D: erect the perpendicular DE, upon which set off the Departure = 2744. join A and E and its done; for the Angle, DAE being measured will be the Course $51^{\circ} 2'$, and AE the Distance 3528 Miles.



NOTE. If the Latitude and Longitude had been taken from Bridge-Town, in Barbadoes, it would have been $1248 N.$ Latitude, and $58^{\circ} 58' W.$ Longitude.

BY CALCULATION.

To find the Course it will be, The Dep. may be found by saying

As the Diff. of Lat.	2219	3	34616	As Radius	10.00000		
Is to the Diff. of Long.	3116	3	50732	Is to Diff. of Lon.	3216	3	50732
So is S. Com. Mid. Lat.	31° 27'	9	93100	So is S. Co. Mi. La.	31° 27'	9	93100
			<u>13.43832</u>				<u>13 43832</u>
			3.34616				<u>10.00000</u>
To the T. of the Cou.	51° 2'	10	09216	To the Departure	2744	3	45832

To find the Distance, it will be,

As the S. Com. Course	51° 2'	9.79856
Is to the Diff. of Lat.	2219	3.34616
So is Radius	—	<u>10.00000</u>
		13.34616
		<u>9.79856</u>
To the Distance	3528	<u>3.54760</u>

BY G U N T E R.

' Extend from Radius to the Com. Middle Latitude 58° 33' on the Line of *Sines*, that Extent will reach from the Difference of Longitude 3216, to the Departure 2744, on the Line of *Numbers*, having the Difference of Latitude and Departure, find the Course and Distance as in Case VI. in *Plane Sailing*.

BY I N S P E C T I O N.

Find the Degrees of the Complement of Middle Latitude in the Table of Difference of Latitude and Departure, which must be considered as a Course; then find the Difference of Longitude in the the Column of Distance; opposite that in the Column of Departure will be the Departure required; having the Difference of Latitude and Departure, find the Course and Distance as in *plane Sailing*.

But

But when it happens to be too large, as in the last Case, divide it by any convenient Number, observing to multiply the Departure, when found, by the same you divide by, the Tables being calculated only for single Degrees; and as the Complement Middle Latitude is 58.33 , I find a 12th of the Difference of Longitude 250 over 58° and 59 ; opposite to which in the Departure Columns stand 227.3 and 229.7, their Sum is 457, Half is 228.5, which being multiplied by 12, gives 2742 for the Departure; with this Departure and Difference of Latitude, find the Course and Distance as in Case VI. in *Plane Sailing*.

C A S E II.

Course and Difference of Latitude given, to find the Departure, Distance, and Difference of Longitude.

Suppose a Ship sails from the Lizard, makes, when the Variation, Lee-way, &c. are allowed for, her Course S. 39° W. or S. W. by S. $\frac{1}{2}$ Westerly, and then by Observation, is in Latitude $45^\circ 31'$ North: What is her Distance run, and Longitude in?

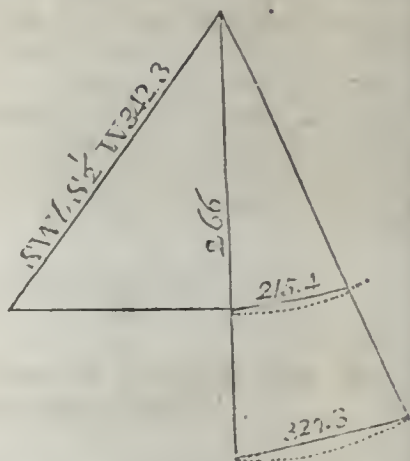
Lat. Lizard	—	$49^\circ 57' \text{ N.}$	$49^\circ 57'$
Lat. by Observation	—	$45 31 \text{ N.}$	$45 31$
Diff. of Lat.		<u>4 26</u>	<u>95 28</u> Sum
		60	
Miles or Minutes	266	<u>47 44</u> Mid. Lat.	<u>90 00</u>
			<u>42 16</u> C. M. Lat.

B Y P R O J E C T I O N .

With the Course 39° and the Difference of Latitude 266, project as in Case II. in *Plane Sailing*, and the Departure will be found 215.4, and Distance 342.3 Miles. With the Sine Com. Middle Latitude $42^\circ 16'$ describe an Arch, upon which set off the Departure on the other Side of the Meridian; from the Center through this last Point draw a Line, then describe an Arch with the Sine of 90° upon the former Center, and that will cut the Meridian and last drawn Line in two Points; the Distance between which, being measured, is 320.3, the Miles of Difference of Longitude.

78 MIDDLE LATITUDE SAILING.

N. B. These Instructions are sufficient to inform the Learner how to project any of the following Cases.



By CALCULATION.

To find the Departure, it will be, To find the Distance, it will be,

As the S. Com. Course, 39°	9.89050	As the S. Course 39°	9.79887
Is to the Diff of Lat. 266	2.42488	Is to the Depart. 215.4	2.33325
So is S. Course 39°	9.79887	So is Radius	10.00000
	<u>12.22375</u>		<u>12.33325</u>
	9.89050		9.79887

To the Departure 215.4 2.33325 To the Distance 342.3 2.53438

To find the Difference of Longitude, it will be,

As S. Com. of Middle Lat. $47^{\circ} 44'$	9.82774
Is to the Departure 215.4	2.33325
So is Radius	10.00000
	<u>12.33325</u>
	9.82774

To the Difference of Longitude 320.3 2.50551

Now as the Longitude left and Difference of Longitude are both W. therefore,

To the Longitude of the Lizard $5^{\circ} 14' W.$
Add the Difference 320 Miles, or $5^{\circ} 20' W.$

The Longitude the Ship is in $10^{\circ} 34' W.$

BY G U N T E R.

‘Extend from 51° to 39° on the Line of *Sines*, that Extent will reach from 266 to 215.4, the Departure on the Line of *Numbers*.’

2dly. Extend from 39° to Radius, that Extent will reach from 215.4 to 342.3, the Distance.’

3dly. ‘Extend from $42^{\circ} 16'$ to Radius on the Line of *Sines*, that Extent will reach from 215.4 to 320.3 the Miles of Difference of Longitude on the Line of *Numbers*.’

BY I N S P E C T I O N.

With the Course 39° and $\frac{1}{2}$ the Difference of Latitude 133, I find the Departure 107.6, and the Distance 171; which being doubled, gives the Departure 215.2 and the Distance 342, nearly as before.

Then with the Sine Complement of Middle Latitude 42° , I look in the Column of Departure for half the Departure 107.6, opposite to that in the Distance Column is 161', which being doubled gives 322, nearly as before, for the Difference of Longitude.

C A S E III.

Both Latitudes and Distance given, to find the Course and Difference of Longitude.

Suppose a Ship runs 300 Miles N. Westerly, from a Port in 37° North Latitude, and Longitude $10^{\circ} 25'$ W. until she be in the Latitude 41° N. What is her Course and Longitude in?

Latitude left	—	37 N.	37°
Latitude in	—	41 N.	41
		4	2) 78 Sum is
		60	
			39 Middle Latitude.
Diff. of Lat. Miles	—	240	90
			51 Com. of Middle Latitude.

8d MIDDLE LATITUDE SAILING.

To find the Course it will be,

To find Diff. of Lon. it will be,

As the Distance	300	2.47712	As S. Com. Mid. Lat. 39°	9 89050
Is to Radius		10.00000	Is to T. of the Cou. $36^{\circ} 52'$	9.87501
So is the Diff. of Lat. 240		2.38021	So is the Diff. of Lat. 240	2.58021
		12.38021		12.25522
		2.47712		9.89050
To the S. Com. Cou. $36^{\circ} 52'$		9 90309	To Diff. of Long. 231.6	2 36472

Longitude Left ———

10.25 W.

Difference of Longitude

3.52 W.

14.17 the Longitude in W.

BY G U N T E R.

'The Extent from the Distance 300 to the Difference of Latitude 240 on the Line of *Numbers*, will reach from Radius to $53^{\circ} 8'$ the Sine Complement of Course on the Line of *Sines*; hence the Course is $36^{\circ} 52'$, or N. W. by N. $\frac{1}{4}$ West nearly.

2dly. 'The Extent from $53^{\circ} 8'$ to $36^{\circ} 52'$ on the Line of *Sines*, will reach from the Difference of Latitude 240, to the Departure 180.

3dly. 'The Extent from 51° the Sine Complement of Middle Latitude to Radius on the Line of *Sines*, will reach from the Departure 180 to the Difference of Longitude 231.6 on the Line of *Numbers*.'

BY I N S P E C T I O N.

With the Distance 300, and Difference of Latitude 240, look in the Tables till they are found to agree in their respective Columns; the nearest to which is 300 and 239.6, under 37° , and opposite to them stands 180.5 in the Column of Departure; then over the Degrees of the Complement of Middle Latitude 51° , and opposite to the Departure 180 stands in the Distance Column 232 for the Difference of Longitude, nearly as before.

These Instructions, being well understood, are sufficient to inform the Reader how to work any of the following Cases.

CASE IV.

Both Latitudes and Departure from the Meridian given, to find the Course, Distance, and Difference of Longitude.

A Ship in Latitude $49^{\circ} 57' N.$ and Longitude $5^{\circ} 24' W.$ fails South-westerly; till the Departure be 789 Miles, and she be in Latitude $39^{\circ} 20' N.$ I demand the Course, Distance, and Longitude the Ship is in?

Latitude left	49 57 N.	49 57 N.
Latitude in	39 20 N.	39 20 N.
	<u>10 37</u>	2) 89 17 Sum is
	60	<u>44 38</u> Middle Latitude.
Differ. of Lat.	637 Miles.	90 00
		<u>45 22</u> Com. Middle Latitude.

As the Diff. of Lat.	637	2.80414	As the S. Course	$51^{\circ} 5'$	9.89101
Is to Radius		10.00000	Is to the Depart.	789	2.89708
So is the Departure	789	2.89708	So is Radius		10.00000
		<u>12.89708</u>			<u>12.89708</u>
		2.80414			9.89101
To the T, of the Cou.	$51^{\circ} 5'$	10.09294	To the Distance	1014	<u>3.00607</u>

As S. Com. Mid. Lat.	$45^{\circ} 22'$	9.85225	Lon. the Ship failed from	5 24 W.
Is to the Departure	789	2.89708	Dif. of Lon.	1109 Miles, or 18 29 W.
So is Radius		10.00000		
		<u>12.89708</u>	Longitude the Ship is in	23 53 W.
		9.85225		
To the Miles Diff. Lon.	1109	<u>3.04483</u>		

82 MIDDLE LATITUDE SAILING.

C A S E V.

One Latitude, Course, and Distance given, to find the Difference of Latitude and Difference of Longitude.

A Ship in Latitude $42^{\circ} 30' \text{ N.}$ and Longitude $18^{\circ} 31' \text{ W.}$ fails S. E. by S. 591 Miles, or 197 Leagues. I demand the Latitude and Longitude the Ship is in?

As Radius	10.00000	Lat left	$42^{\circ} 30' \text{ N.}$
Is to the Distance 591	2.77159	Di. Lat. 491	} 8 11 S.
So is S. Com. Course 3 Pts.	9.91985	Miles, or	
	<u>12.69144</u>		<u>34 19 N.</u>
	10.00000		
To the Diff. of Lat. 491.4	<u>2.69144</u>	Latitude left	$42 30$
		Latitude in	<u>34 19</u>
As the S. Co. Mid. L. $38^{\circ} 24'$	9.89415		<u>76 49</u> Sum is
Is to the S. Course 3 Pts.	9.74474		
So is the Distance 591	2.77159		<u>38 24</u> Mid. Lat. ;
	<u>12.51633</u>		<u>90 00</u>
	9.89415		<u>51 36</u> Co. M. Lat.
To the Diff. of Long. 419	<u>2.62218</u>	Lon. the Ship failed from	$18 31 \text{ W.}$
		Diff. of Long. 419, or	<u>6 59 E.</u>
		Long. in	<u>11 32 W.</u>

C A S E VI.

One Latitude, Course, and Departure given, to find the Distance, Difference of Latitude, and Difference of Longitude.

A Ship fails E. S. E. from a certain Port, in Latitude $50^{\circ} 10' \text{ S.}$ and Longitude $10^{\circ} 16' \text{ E.}$ until her Departure from the Meridian be 957 Miles; I demand her Distance failed, and the Latitude and Longitude the Ship is in?

As the S. Course 6 Pts.	9.96562	Latitude left	$50^{\circ} 10' \text{ S.}$
Is to the Dep. 957	2.98091	Diff. Lat. 396, or	<u>6 36 S.</u>
So is S. Com. Cou. 6 Pts.	9.58284		
	<u>12.56375</u>	Latitude in	<u>56 46 S.</u>
	9.96562		
To the Diff. of Lat. 396.4	<u>2.59813</u>		

MIDDLE LATITUDE SAILING. 83

As Sine Course	6 Pts.	9.96562	Lat. left	50° 10' S.
Is to the Depart.	957	2.98091	Lat. in	56 46 S.
So is Radius		10.00000		
			2) 106	56 Sum is
		12.98091		
		9.96562		53 28 Mid. Lat.
				90 00
To the Distance	1036	3.01529		
				36 32 Com. Mid. Lat.
As the S. Com. Mid. Lat.	53° 28'	9.77473		
Is to the Depart.	957	2.98091	Long. left is	10° 16' E.
So is Radius		10.00000	Diff. Lon. 1608, or	26 48 E.
		12.98091	Long. in	37 4 E.
		9.77473		
To the Miles Diff. of Long.	1608	3.2618		

C A S E VII.

One Latitude, Distance sailed, and Departure from the Meridian given, to find the Course, Difference of Latitude, and Difference of Longitude.

A Ship in Latitude 49° 30' N. and Longitude 14° 40' W. fails South Eastward 645 Miles, until her Departure from the Meridian be 500 Miles; I demand the Course steered, and the Latitude and Longitude the Ship is in?

As the Distance	645	2.80956	As Radius	10.00000
Is to Radius		10.00000	Is to the Distance	645 2.80956
So is the Departure	500	2.69897	So is S. Co. Cou.	50° 50' 9.80043
		12.69897		12.60999
		2.80956		10.00000
To S. Course	50° 50'	9.88941	To the Diff. of Lat.	407.3 2.60999
Lat. left is	49° 30' N.		Lat. left	49 30
Diff. Lat. 407, or	6 47 S.		Lat. in	42 43
Lat. in	42 43 N.		Sum is	92 13
			Middle Lat.	46 6
				90
			Com. Mid. Lat.	43 54

As S. Com. Mid. Lat. 46.6 9.84098

Is to the Departure 500 2.69897

So is Radius 10.00000

12 69897

9.84098

Long. left

Diff. Lon. 721, or

Long. in

14° 40' W.

12 01 E.

2 39 W.

To the Diff. of Long. 721.1 2.85799

TO SOLVE a Traverse in MIDDLE LATITUDE SAILING.

How to *Solve* compound Courses, or Traverses on the Principles of *Plane Sailing*, has already been shewn; but it is necessary also to shew how the proper Allowances for Longitude are to be introduced into such Accounts, which is easily done, by either of the following Methods.

1st. Complete the Traverse Table to each Course and Distance, and find the whole Difference of Latitude, Departure, and Latitude come to.

2dly. With the whole Difference of Latitude and Departure, find the direct Course and Distance.

3dly. With the Latitude left and the Latitude come to, find the Complement Middle Latitude; with which and the Departure, find the Difference of Longitude.

This Method is generally used in working a Day's Work at Sea; but those that want more Accuracy may work by the following Method, which should always be done in Latitudes exceeding 51 or 52° where the Meridians converge very fast, and the nearer the Poles the greater will be the Error; but the following Method will be exact enough in any Latitude where Navigation is practical.

By the several Differences of Latitude found in the Traverse Tables, find the Latitudes come to, Middle Latitudes, and Complement Middle Latitudes; with each Complement Middle Latitude and corresponding Departure, find the Difference of Longitude to each Course, and set them down in the Columns marked East or West, according to the Departure used: Add up both the East and West Columns of Longitude, and the Difference of their Sums will be the whole Difference of Longitude.

Hence the Longitude in, at the End of each Course may be readily found by adding the Difference to, or subtracting it from the Longitude left, according as the Case requires; as may be seen in the following Traverse.

EXAMPLE.

Suppose a Ship from the Land's End, in Latitude 50° 60' N. and Longitude 6° W. is bound to Gibraltar in the Latitude 36° 12' N. and Longitude 4° 53' W. but by reason of contrary Winds is obliged to sail as follows, viz. S. by W. 24 Miles, W. S. W. 32 N.

N. W. $\frac{1}{2}$ W. 41, S. S. E. $\frac{1}{4}$ E. 49, E. N. E. $\frac{3}{4}$ E. 19, W. 21, N. E. $\frac{1}{2}$ E. 36, S. 41, S. S. W. 92, and N. 36; I demand the Latitude and Longitude the Ship is in, and what Course she must steer, and how far, to gain her intended Port?

With the Difference of Latitude and Difference of Longitude between the Land's End and Gibraltar, the direct Course is found by Case I. to be S. $3^{\circ} 21'$ E. or S. $\frac{1}{4}$ E. nearly, and Distance 835 Miles,

Now to work the above TRAVERSE.

Find the Difference of Latitude and Departure for each Course and Distance, either by Inspection or otherwise, as taught in *Plane Sailing*; which set down in the Traverse Table in their proper Columns.

Add to the Traverse Table 4 Columns, in which write Diff. Long. Long. in, and Lat. in.

Then with the Difference of Latitude and Departure belonging to the first Course, proceed to find the Latitude in, Middle Latitude, Complement Middle Latitude, Difference of Longitude, and Longitude in, as follows:

Lat. Land's End	50° 6' N.	As the S. Com. Mid. Lat.	49.54	9.80897
Diff. Lat.	00 23 S.	Is to the Departure	4.7	0.67210
		So is Radius		10.00000
Lat. in	49 43			
Latitude left	50 6			10.67210
				9.80897
The Sum	99 49			
		To the Diff. of Longitude	7.3	0.86313
Mid. Lat.	49 54			
	90			
Com. Mid. Lat.	40 06			

Now to the Diff. of Longitude	6° 0' W.
Add the Diff. of Longitude	0 7 W.
Longitude in	6 7

In like Manner proceed with the other Courses, and when found as above, will stand as in the following Traverse Table.

NOTE. In adding or subtracting the Latitude and Longitude, if the Tenths in the Difference be above 5, call them 1, if not, reject them.

The

The TRAVERSE TABLE.

Courses.	Ditt.	Diff. Lat.		Departure		Diff. Long.		Lat. in.	Lon. in.
		N.	S.	E.	W.	E	W.		
								50. 6 — .23	6. 0 + .7
S. by W.	24		23.5		4.7		7.3	49.43 — 12	6. 7 + .46
W. S. W.	32		12.2		29.6		45.7	49.31 + .26	6.53 + .49
N. W. $\frac{1}{2}$ W.	41	26.0			31.7		49.	49.57 — .44	7.42 — .32
S. S. E. $\frac{1}{4}$ E.	49		44.3	21.0		32.4		49.13 + .5	7.10 — .28
E. N. E. $\frac{3}{4}$ E.	19	4.6		18.4		28.2		49.10 0.00	6.42 + .32
W.	21				21.		32.2	49.18 + .23	7.14 — .43
N. E. $\frac{1}{2}$ E.	36	22.8		27.8		42.8		49.41 — .41	6.31 0
S.	41		41.0					49. 0 — 1 25	6.31 + .53
S. S. W.	92		85.0		35.2		53.0	47.35 + .36	7.24 0.00
N.	36	36.0						48.11	7.24
		89.2	206.0	67.2	122.2	103.4	187.2		
			89.4		67.2		103.4		
		Diff. Lat	116.6	Dep	55.		82.8		

Hence it is plain, that the Ship has made of Southing 116.6, or 117 Miles, = $1^{\circ} 57'$, which being subtracted from the Latitude left $50^{\circ} 6'$, leaves $48^{\circ} 9'$ the Latitude in; it's differing 2 Miles from that standing in the Tables, is owing to the Tenths happening to be taken too large in finding the successive Latitudes.

N. B. The Column of Long. in, may be omitted, for if the whole Diff. of Long. be added to the Long. left, it will give the Long. in.

MIDDLE LATITUDE SAILING. 87

The Meridional Distance or Departure is 55 Miles West, and the Difference of Longitude 83.8 or 84 Miles = $1^{\circ} 24'$ West, which being added to the Longitude left $6^{\circ} 0'$, gives $7^{\circ} 24'$ W. the Longitude in, the same as in the Table.

Now to find the direct Course and Distance to the intended Port.

From the Lat. in	48° 9'	48. 9	From the Lon. in	7° 24' W.
Take the Lat. Gibraltar	36 12	36.12	Take Lon. Gibra.	4 53 W.
	<u>11 57</u>	<u>84.21</u>	Sum is. Diff. of Long.	<u>2 31</u>
	60			60
	<u>17 17</u>	<u>42.10</u>	Mid. Lat.	
Diff. Lat. in Miles			In Miles	<u>151 E.</u>

As the Diff. of Lat.	717	2.85552	As S. Com Cou. $8^{\circ} 52'$	9.99478
Is to the Diff. of Long.	151	2.17898	Is to the Diff. of Lat.	717
So is S. Com. Mid. Lat.	42.10	9.86993	So is Radius	10.00000
		<u>12.04891</u>		<u>12.85552</u>
		2.85552		9.99478
To the Tang. Course	$8^{\circ} 52'$	9.19339	To the Distance	725.7
				<u>2.86074</u>

Hence the direct Course to Gibraltar is S. $8^{\circ} 52'$ E. or S. $\frac{3}{4}$ E. Distance 726 Miles.

Though this Method of finding the Difference of Longitude for each Course and Distance be true, yet on account of its being tedious, is never practised at Sea. The Mariner only finds the Difference of Latitude by Inspection for each Course and Distance, as in *Plane Sailing*; and having the Latitude left, and the Difference of Latitude, and consequently the Latitude in, with the Sine Complement Middle Latitude, and the whole Departure, finds the Difference of Longitude made upon the several Courses, which is of sufficient Exactness for any Day's Run, as may be seen by the following Operation.

Lat. left	50° 6'	As the Sine Com. Mid. Lat.	49° 7'	9.81592
Lat. in	48 9	Is to the Departure	55	1.74036
	<u>2) 98 15</u>	So is Radius	<u>—</u>	<u>10.00000</u>
Sum is				
Mid. Lat.	<u>49 7</u>			<u>11.74036</u>
				9.81592
		To the Diff. of Long.	84	<u>1.92444</u>

Nearly the same as found by the other Method.

All the above may be wrought by Inspection, or by Gunter, but I shall leave it for the Learner's Practice, and proceed to the true Method of Sailing, invented by Mr. Edward Wright, commonly called *Mercator's Sailing*.

MERCATOR'S SAILING.

PLANE SAILING, as has been before observed, supposes the Earth and Sea to be in the Form of a Bowling-Green, on which the Meridians are parallel, and the Degrees of Latitude and Longitude equal in all Places; but the Earth and Sea is a round Body or Globe, on which the Degrees of Latitude are equal in all Places, and the Degrees of Longitude decrease from the Equator in Proportion to the Sine Complement of the Latitude.

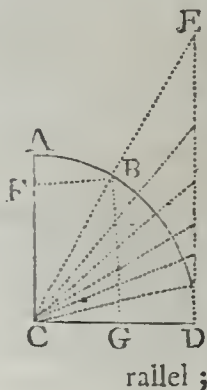
Though the Meridians do all meet at the Pole, and the Parallels to the Equator do continually decrease, and that in Proportion to the Co-Sines of their Latitudes; yet in old Sea Charts the Meridians were drawn parallel to each other, and consequently the Parallels of Latitude made equal to the Equator, and so a Degree of Longitude on any Parallel, as large as a Degree on the Equator: Also in these Charts the Degrees of Latitude were still represented (as they are in themselves) equal to each other, and to those of the Equator; by these Means the Degrees of Longitude being increased beyond their just Proportion, and the more so the nearer they approach the Pole, the Degrees of Latitude at the same time remaining the same, it is evident Places must be very erroneously marked down upon those Charts with respect to their Latitude and Longitude, and consequently, their Bearing from one another very false.

To remedy this Inconvenience, so as still to keep the Meridians parallel, it is plain we must protract or lengthen the Degrees of Latitude in the same Proportion as those of Longitude are, that so the Proportion in Easting or Westing may be the same with that of Northing or Southing; and consequently the Bearing of Places from each other be the same upon the Chart as upon the Globe itself.

Now to discover how the Meridians are expanded from the Equator, in Proportion to the Degrees of Longitude decreasing towards the Poles.

Let ABD in the annexed Scheme, represent the Quarter of a Meridian; FB, the Radius of a Parallel of Latitude; now CG, which is equal to FB, is to CD, as a Degree on the Parallel is to a Degree on the Meridian, or any great Circle; and as CG is to CD, so is CB to CE, the Secant of the Latitude of the Parallel.

Therefore in a Projection of the Globe where the Meridians are kept parallel, it is evident, a Degree on the Meridian at any Parallel must be equal to the Secant of the Latitude of that Pa-



parallel; and the Distance of any Point, upon the Meridian, from the Equator, is equal to the Sum of the Secants contained between it and the Equator.

Hence it is evident, that by a continual Addition of Secants, beginning at the Equator, a Table of Meridional Parts may be composed for every Degree and Minute in the Quadrant.

Therefore the Meridional Difference of Latitude between any two Places may be easily found, by finding the Meridional Parts answering to both Latitudes, and either adding or subtracting, according as the Case requires; that is, if both North, or both South, subtract; but if one North and the other South added, gives the Meridional Difference of Latitude between them: But the Meridional Difference of Latitude between any Place and the Equator is found, by taking the Meridional Parts belonging to the Latitude of that Place.

To find the Meridional Parts belonging to any Number of Degrees and Minutes of Latitude acquired.

In the Table of Meridional Parts, seek the Degrees on the upper Part of the Table, and in the left or right Hand Column the Minutes marked on the Top with M. opposite to which, and under the Degrees is the Meridional Parts required.

Suppose the Meridional Parts belonging to $57^{\circ} 18'$ were required?

Look in the Table under 57° , and opposite to $18'$ stands 4216, the Meridional Parts of $57^{\circ} 18'$.

The same may be observed of any Degrees and Minutes required?

Now in order to work the following Problems, observe, that the Meridional Difference of Latitude, bears the same Proportion to the Difference of Longitude, that the proper Difference of Latitude does to the Departure; and that the Sine of the Course, bears the same Proportion to the Difference of Longitude, as the Sine Complement of the Course does to the Meridional Difference of Latitude.

CASE I.

The Latitude and Longitude of two Places given, to find the Course and Distance between them.

What is the Course and Distance from the Lizard to the Island of Barbadoes?

M

Lat.

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Lat. of the Lizard	49° 57' N.	Merid. Parts	3470	Lon. 5.14 W.
Lat. of Barbadoes	12. 58 N.	————	785	Lon. 58.50 W.
	<u>36. 59</u>	Merid. Diff. Lat.	<u>2685</u>	<u>53.36</u>
	60			60

Proper Diff. Lat. in Miles 2219

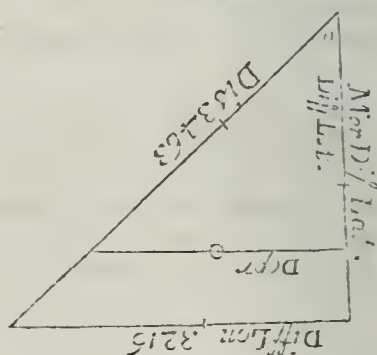
Diff. Long. 3216 Miles.

By PROJECTION.

Draw the Meridian, and upon it set off the Meridional Difference of Latitude 2685 Miles, the upper End of which will represent the Lizard, and upon the other raise a Perpendicular, which make equal to 3216, the Difference of Longitude; between that and the Lizard draw a Line, and the Angle which it makes with the Meridian will be the Course.

2dly. Take in your Compasses 2219 the proper Difference of Latitude, and lay it from the Lizard upon the Meridian, and through where it cuts, draw a Line parallel to the Difference of Longitude, which will be the Departure; and the Point where it cuts the Hypothenufe will represent Barbadoes; the Distance between which, and the Lizard being measured on the same Scale, will be 3463 Miles, the Distance required.

See the Note in Case I. *Middle Latitude Sailing.*



By CALCULATION.

To find the Course, it will be,

To find the Dist. it will be,

As the Mer. Diff. of Lat. 2685 3.42894
Is to Radius 10.00000
So is the Diff. of Long. 3216 3.50732

As the S. Com. Cou. 50° 9' 9.80671
Is to proper Diff. Lat. 2219 3.34616
So is Radius 10.00000

13.50732
3.42894

13.34616
9.80671

To the T. of the Cou. 50° 9' 10.07838

To the Distance 3463 3.53945

Hence

MERCATOR'S SAILING. 91

Hence the direct Course between the Lizard and Barbadoes is S. $50^{\circ} 9'$ West, or S. W. $\frac{1}{2}$ W. nearly, Distance 3463 Miles.

By GUNTER.

'The Extent from the Meridian Difference of Latitude 2685 to the Difference of Longitude 3216, on the Line of *Numbers*, will reach from Radius to $50^{\circ} 9'$, on the Line of *Tangents*.

2dly. 'The Extent from the Sine Complement Course $39^{\circ} 51'$ to Radius on the Line of *Sines*, will reach from the proper Difference of Latitude 2219, to the Distance 3463, on the Line of *Numbers*.

By INSPECTION.

Seek the Meridian Difference of Latitude and Difference of Longitude together in the Tables, like Difference of Latitude and Departure, and the Course will be found among the Degrees.

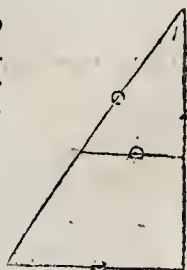
Then with the Course and proper Difference of Latitude, find the Distance; in the last Case it will be thus: The 20th Part of 3216 and 2685 are 160.8 and 135.3 nearly; the nearest to which in the Table are 135 and 160 over 50° , then with the Course 50° and 20th of the Difference of Latitude 111 nearly, opposite to that in the Distance Column stands 173; which being multiplied by 20, is 3460 the Distance, nearly the same as before.

CASE II.

Both Latitudes and Course given, to find the Distance and Difference of Longitude.

A Ship sails from the Lizard, and makes her Course S. 39° W. or S. W. by S. $\frac{1}{2}$ W. and then by Observation is in Latitude $45^{\circ} 31'$ N. I demand the Distance run, and Longitude she is in?

Lat. of the Lizard	$49^{\circ} 57'$ N.	Meridian Parts	3470
Lat. by Observation	$45^{\circ} 31'$ N.	Meridian Parts	3074
	<u>4 26</u>	Mer. Diff. of Lat.	<u>396</u>
	60		
Proper Diff. of Lat.	<u>266</u>		



B Y P R O J E C T I O N .

Draw a Meridian, the lower End of which will represent the Ship's Place in her first Latitude.

Take the proper Difference of Latitude 266 in your Compasses and with one Foot in the Ship's Place, lay the other upon the Meridian, then take the Meridian Difference of Latitude 396 in your Compasses, and with one Foot in the Ship's Place, as before, lay the other upon the Meridian, and upon these two Points raise Perpendiculars, then a Line drawn from the Ship's Place, making an Angle with the Meridian equal to 39° the Ship's Course, will cut the two Perpendiculars; the first will be the Departure, which terminates the Distance 342, and the other will be the Difference of Longitude 321 Miles.

From what has been said, it is plain that any Case in *Mercator's Sailing* may be projected as a Right-angled Triangle, by only considering the Difference of Longitude or Departure, as the Base; the Meridian, or proper Difference of Latitude, as the Perpendicular; the Hypothenuse cut by the Departure, as Distance; and the Angle which that makes with the Perpendicular, the Course; for in all Cases in *Mercator's Sailing*, the Meridian Difference of Latitude bears the same Proportion to the Difference of Longitude, that the proper Difference of Latitude does to the Departure.

These Instructions, being well understood, will be sufficient to inform the Learner how to construct any of the following Cases.

B Y C A L C U L A T I O N .

To find the Distance

To find the Diff. of Long.

As the S. Com. Cou. 39°	9.89050
Is to the Diff of Lat. 266	2.42488
So is Radius	10.00000
	12.42488
	9.89050

As the S Com. Cou. 39°	9.89050
Is to Mer. Diff. Lat. 396	2.59770
So is S. Course	39° 9.79887
	12.39657
	9.89050

To the Distance 342.3 2.53438To the Diff. of Long. 320.7 2.50607

Long. left
Diff. of Long. 321, or

5° 14' W.
5 21 W.

Long. in

10 35 W.

BY G U N T E R.

'The Extent. from 51° to Radius on the Line of *Sines*, will reach from the proper Difference of Latitude 266, to the Distance 342.3, on the Line of *Numbers*.'

2dly. 'The Extent from 51° to 39° on the Line of *Sines*, will reach from the Meridian Difference of Latitude 396, to the Difference of Longitude 321, on the Line of *Numbers*.'

BY I N S P E C T I O N.

Under the Course 39° , and against $\frac{1}{2}$ the Difference of Latitude 133, stands 171 in the Distance Column, which being doubled is 342 the Distance; under the same Degrees and in the Latitude Column, look for $\frac{1}{2}$ the Meridian Difference of Latitude 198, against that in the Departure Column stands 160.5, doubled is 321, the Difference of Longitude.

C A S E III.

Both Latitudes and Distance given, to find the Course and Difference of Longitude.

If a Ship runs 300 Miles N. Westward from a Port in Latitude 37° N. and Longitude $10^{\circ} 25'$ W. until she be in Latitude 41° N. I demand the Course steered, and Longitude she is in?

Lat. left	37° N.	Merid. Parts	{ 2393
Lat. in	41° N.		{ 2702
	4	Mer. Diff. of Lat.	309
	60		



Proper Diff. of Lat. 240

As the Distance	300	2.47712	As S. Com. Cou.	$36^{\circ} 52'$	9.90311
Is to Radius		10.00000	Is to Mer. Diff. Lat.	309	2.48996
So is proper Diff. Lat.	240	2.38021	So is S. Course	$36^{\circ} 52'$	9.77812
		12.38021			12.26808
		2.47712			9.90311
To S. Com. Cou.	$36^{\circ} 52'$	9.90309	To Miles Diff. Lon.	231.7	2.36497

Long

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Long left	10° 25' W.
Diff. of Long. 231, or	3 51 W.
Long. in	<u>14 16 W.</u>

By G U N T E R.

'The Extent from the Distance 300, to the proper Difference of Latitude 240, on the Line of *Numbers*, will reach from Radius to 53° 8' on the Line of *Sines*.'

2dly. 'The Extent from 53° 8' to 36° 52' on the Line of *Sines*, will reach from the Meridian Difference of Latitude 309, to the Difference of Longitude 231.7, on the Line of *Numbers*.'

By I N S P E C T I O N.

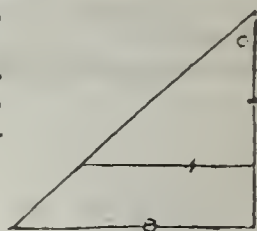
Half the Distance 150, and $\frac{1}{2}$ the Difference of Latitude 120, will be found standing together in their Columns, nearly under 37°, the Course; and in the Latitude Column, find $\frac{1}{2}$ the Meridian Difference of Latitude 154.5, the nearest to it is 154.1; against which in the Departure Column stands 116.1, doubled is 232.2, the Difference of Longitude, nearly as before.

C A S E IV.

Both Latitudes and Departure from the Meridian given, to find the Course, Distance, and Difference of Longitude.

A Ship in Lat. 49° 57' N. and Longitude 5° 14' W. sails S. Westward till her Departure from the Meridian is 789 Miles, and by Observation is in Latitude 39° 20' N. I demand her Course steered, Distance sailed, and what Longitude she is in?

Lat. left	49° 57' N.	Mer. Parts	{ 3470
Lat. by Observ.	39 20 N.		{ 2571
	<u>10 37</u>	Mer. Diff. Lat.	<u>899</u>
	60		
Proper Diff. Lat.	<u>637</u>		



As

MERCATOR'S SAILING. 95

As the Diff. of Lat. 637	2.80414	As S. Course	51° 5'	9.89101
Is to Radius	10.00000	Is to the Departure	789	2.89708
So is the Departure	789	So is Radius		10.00000

12 89708
2.80414

12.89708
9 89101

To Tang. Course	51° 5'	10.09294	To the Distance	1014	3.00607
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As S. Com Course	51° 5'	9.79809	Long. left	5° 14'
Is to the Mer. Diff. of Lat. 899	2.95376		Diff. of Long. 1114, or	18 34
So is S. Course	51° 5'	9.89101		

12 84477
9.79809

Long. in West 23 48

To the Diff. of Long.	1114	3.04668
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BY G U N T E R.

'The Extent from the Difference of Latitude 637, to the Departure 789, on the Line of *Numbers*, will reach from Radius to 51° 5', on the Line of *Tangents*.'

2dly. 'The Extent from 51° 5' to Radius on the Line of *Sines*, will reach from the Departure 789, to the Distance 1014, on the Line of *Numbers*.'

3dly. 'The Extent from 38° 55' to 51° 5', on the Line of *Sines*, will reach from the Merid. Difference of Latitude 899, to the Difference of Longitude 1114, on the Line of *Numbers*.'

BY I N S P E C T I O N.

The Difference of Latitude and Departure being found together, will give the Course among the Degrees, and the Distance in its Column.

In the Latitude Column belonging to the Degrees of the Course, find the Merid. Difference of Latitude; opposite to that in the Departure Column will be the Difference of Longitude.

Now a 6th of the Difference of Latitude 637, and of the Departure 789, are 106.1, and 131.5; the nearest to these are found over the Course 51°, and the Distance 169, being multiplied by 6, is 1014, the same as before.

In

96 M E R C A T O R ' s S A I L I N G .

In the Latitude Column over the same Degrees, look for a 6th of the Merid. Difference of Latitude $899 = 149.8$; against that in the Departure Column stands 185, multiplied by 6, is 1110 for the Difference of Longitude.

C A S E V.

One Latitude, Course, and Distance given, to find the Difference of Latitude and Difference of Longitude.

A Ship in Latitude $42^{\circ} 30' N.$ and Longitude $18^{\circ} 31' W.$ fails S. W. by S. 591 Miles. I demand the Latitude and Longitude the Ship is in?

As Radius	10.00000	Lat. left	$42^{\circ} 30'$	Mer. Parts	$\left\{ \begin{array}{l} 2822 \\ 2194 \end{array} \right.$
Is to the Diff. 591	2.77159	Dif. Lat. 491, or	$8 \quad 11$		
So is S. Co. Cou. 3 Pts.	9.91985	Lat. in	$34 \quad 19$	Mer. Dif. Lat. 628	
	<u>12.69144</u>				
	10.00000				
	<u>2.69144</u>				
To the Diff. Lat. 491.4	2.69144				

As the S. Com. Course	3 Pts.	9.91985	Long. left.	$18^{\circ} 31' W.$
Is to the Mer. Diff. of Lat.	628	2.79796	Dif. Lon. 420, or	$7 \quad 0 W.$
So is S. Course	3 Pts.	9.74474	Long. in	$25 \quad 31 W.$
		<u>12.54270</u>		
		9.91985		
To the Miles Diff. Long. 419.6		<u>2.62285</u>		

B Y G U N T E R.

The Extent from Radius to 5 Pts. on the Line marked S. R. will reach from the Distance 591, to the Difference of Latitude 491.4 on the Line of Numbers.

2dly. The Extent from 5 Pts. to 3 Pts. on the Line marked S. R. will reach from the Merid. Difference of Latitude 628, to the Difference of Longitude 419.6, on the Line of Numbers.

BY INSPECTION.

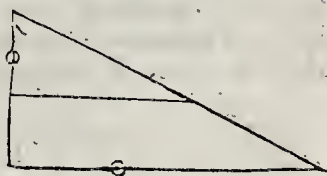
Under the Course 3 Pts. and opposite a 10th of the Distance 59.1, in the Latitude Column stands 49.1, which multiplied by 10, is 491, the Difference of Latitude; then find $\frac{1}{4}$ of the Meridian Difference of Latitude 157, in the Latitude Column; against which stands 105 in the Departure Column; which, multiplied by 4, gives 420, the Difference of Longitude.

CASE VI.

One Latitude, Course, and Departure given, to find the Distance, Difference of Latitude, and Difference of Longitude.

A Ship sails E. S. E. from a certain Port in Latitude $50^{\circ} 10' S.$ and Longitude $10^{\circ} 16' E.$ until her Departure from the Meridian be 957 Miles. I demand the Distance sailed, and the Latitude and Longitude she is in?

As the S. Course	6 Pts.	9.96562
Is to the Departure	957	2.98091
So is Radius		10.00000
		12.98091
		9.96562
To the Distance	1036	3.01529



As the S. Course 6 Pts.	9.96562	Lat. left	$50^{\circ} 10' S.$	Mer. Parts	{ 3490
Is to the Depart. 957	2.98091	Dif. La.	396, or 6	36 S.	{ 4157
So is S. Com. Cou. 6 Pts.	9.58284				
		Lat. in	56 46 S.	Mer. Dif. Lat.	667
	12.56375				
	9.96562				
To the Dif. of Lat.	396.4				

As S. Com. Course 6 Pts.	9.58284	Long. left	$10^{\circ} 16' E.$
Is to the Mer. Dif. of Lat. 667	2.82413	Dif. Long.	1610, or 26 50 E.
So is the S. Course 6 Pts.	9.96562		
		Long. in	37 6 E.
	12.78975		
	9.58284		
To the Dif. of Long.	1610		

BY G U N T E R.

'The Extent from 6 Pts. to Radius on the Line marked S. R. will reach from the Departure 957, to the Distance 1036, on the Line of *Numbers*.'

2dly. 'The Extent from 6 Pts. to 2 Pts. on the Line marked S. R. will reach from the Departure 957, to the Difference of Latitude 396.4, on the Line of *Numbers*.'

3dly. 'The Extent from 6 Pts. to 2 Pts. on the Line marked S. R. will reach from the Merid. Difference of Latitude 667, to the Difference of Longitude 1610, on the Line of *Numbers*.'

BY I N S P E C T I O N.

Over the Course 6 Pts. and against a 5th of the Departure 191.4, stands 79.2 and 207, which multiplied by 5, gives 396, the Difference of Latitude, and 1035 for the Distance.

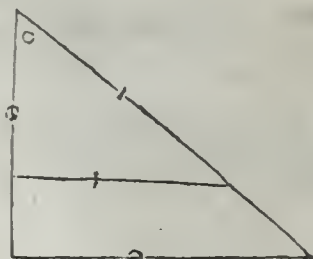
Then in the Latitude Column find a 10th of the Meridian Difference of Latitude 66.7. the nearest to that is 66.6; against which, in the Departure Column stands 160.8, multiplied by 10, is 1608, the Difference of Longitude.

C A S E VII.

One Latitude, Distance sailed, and the Departure from the Meridian given, to find the Course, Difference of Latitude, and Difference of Longitude.

A Ship in Latitude $49^{\circ} 30' N.$ and Longitude $14^{\circ} 40' W.$ fails S. Eastward 645 Miles, until the Departure from the Meridian be 500 Miles. I demand the Course steered, and the Latitude and Longitude she is in?

As the Distance	645	—	2.80956
Is to Radius			10.00000
So is the Departure	500		2.69897
			12.69897
			2.80956
To the S. Course	$50^{\circ} 50'$		9.88941



Hence the Course is $50^{\circ} 50' E.$ or S. E. $\frac{1}{2} E.$ nearly.

As

As the S. Cou.	50° 50'	9.88948.			
Is to the Depart.	500	2.69897	Lat. left	49° 30' N.	Mer. P. { 3428 2840
So is S. Co. Cou.	50° 50'	9.80043	Dif. La.	407, or 6 47 S.	
		<u>12.49940</u>	Lat. in	<u>42 43</u>	N.M. Dif. La. <u>588</u>
		9.88948			
To the Diff. of Lat.	407	<u>2.60992</u>			

As S. Com. Course	50° 50'	9.80043			
Is to the Mer. Diff. of Lat.	588	2.76938	Long. left	14° 40' W.	
So is S. Course	50 50	9.88948	Dif. of Lon.	722, or 12 02 E.	
		<u>12.65886</u>	Long. in	<u>2 38</u>	W.
		9.80043			
To the Diff. of Lon.	721.8	<u>2.85843</u>			

BY G U N T E R.

' The Extent from the Distance 645, to the Departure 500 on the Line of *Numbers*, will reach from Radius to 50° 50' on the Line of *Sines*.

2dly. ' The Extent from 50° 50' to 39° 10' on the Line of *Sines*, will reach from the Departure 500, to the Difference of Latitude 407, on the Line of *Numbers*.'

3dly. ' The Extent from 50° 50' to 39° 10' on the Line of *Sines*, will reach from the Meridian Difference of Latitude 588, to the Difference of Longitude 722, on the Line of *Numbers*.

BY I N S P E C T I O N.

Now a 5th of the Distance and Departure are 129 and 100, and are found together over 51°; and in the Latitude Column stands 81.2, which multiplied by 5, is 406, the Difference of Latitude.

Then in the Latitude Column seek $\frac{1}{4}$ of the Merid. Difference of Latitude 147, the nearest is 146.6; against which in the Departure Column stands 181.1, multiplied by 4, is 724.4, the Difference of Longitude.

How to *solve* a Traverse, has been already shewn both in *Plane* and *Middle Latitude Sailing*; we shall now proceed to shew how to make proper Allowances for Longitude, according to *Mercator's Sailing*, which may be easily done by any of the following Methods:

Rule I. Complete the Traverse Table as in Plane Sailing, and with the whole Difference of Latitude and Departure, find the direct Course, Distance, and Latitude in; with the Latitude left, and the Latitude in, find the Meridional Difference of Latitude; with which, and the Course, (found as above) find the whole Difference of Longitude made upon the several Courses.

This Method is in common practised at Sea, but those that want a greater Degree of Accuracy, may use the following, which should always be done in Latitudes higher than 51 or 52, as has been observed in Middle Latitude Sailing.

Rule II. To the Traverse Table annex four Columns, in which write Latitude in, Difference of Longitude, and Longitude in.

With the Latitude left, and Difference of Latitude, find the Latitude in Meridional Difference of Latitude for each Course.

To each Course, and its corresponding Meridional Difference of Latitude, find the Difference of Longitude, which set down in its proper Column.

The Difference of the Sums of the East and West Columns of Longitude will give the Difference of Longitude; or with the Difference of Longitude find the Longitude in, at the End of each Course.

These Methods will be exemplified in the following Traverse, which is the same that was taken in *Middle Latitude Sailing*, that the Learner may see the Difference between *Middle Latitude Sailing* and *Mercator's Sailing*.

E X A M P L E.

Suppose a Ship from the Land's End, in Latitude $50^{\circ} 6' N.$ and Longitude $6.0 W.$ is bound to Gibraltar, in Latitude $36^{\circ} 12'$, and Longitude $4^{\circ} 53' W.$ but by reason of contrary Winds is obliged to sail as follows; viz. S. by W. 24 Miles, W. S. W. 32, N. W. $\frac{1}{2}$ W. 41, S. S. E. $\frac{1}{4}$ E. 49, E. N. E. $\frac{3}{4}$ E. 19, W. 21, N. E. $\frac{1}{2}$ E. 36, S. 41, S. S. W. 92, N. 36. I demand the Latitude and Longitude the Ship is in, and what Course she must steer, and how far, to gain her intended Port?

With the proper Difference of Latitude 834, Meridional Difference of Latitude 1151, and Difference of Longitude 67, the Course between the Land's End and Gibraltar is found to be S. $3^{\circ} 20'$ Easterly, or S. $\frac{1}{4}$ E. nearly, and Distance 835 Miles.

Then

Then with the Difference of Latitude and Departure belonging to the first Course, find the Latitude in, Meridional Difference of Latitude, Difference of Longitude, and Longitude in.

Latitude left	50° 6' N.	Merid. Parts.	{ 3484
Difference of Latitude	23 S.		{ 3448

Latitude in	<u>49 43 N.</u>	Mer. Diff. Lat.	<u>36</u>
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As Sine Com. Course	1 Pt.	9.99157
Is to the Mer. Diff. of Lat.	36	1.55630
So is Sine Course	1 Pt.	9.29024

10.84654
9.99157

To the Diff. of Longitude	7.1	<u>0.85497</u>
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Long. left	6° 00' W.
Diff. of Long.	7 W.

Long. in	<u>6 7 W.</u>
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Now as the Difference of Longitude being W. it must be set in the Column marked W. and so with the rest, but we shall leave the Operations to exercise the Learner, and proceed to shew how to work the same.

BY INSPECTION.

Look in the Table under 1 Pt. in the Latitude Column for Meridional Difference of Latitude 36; the nearest is 36.3, against which, in the Departure Column stands 7.2 for the Difference of Longitude, which set down as before directed.

In like manner proceed with the other Courses, and when found, will stand nearly as in the following TRAVERSE TABLE, always adding or subtracting the Difference of Latitude and Difference of Longitude as the Case requires, to find the Latitude and Longitude in at the End of each Course; or, without finding the Longitude in at the End of every Course, find the whole Difference of Longitude, and with that and the Longitude left find the Longitude in, which is rather better, as the frequent Omission of Tenths may make a small Difference.

The

The TRAVERSE TABLE.

Courses.	Dist.	Diff. Lat.		Departure		Lat. in.	Diff. Long.		Lon. in.
		N.	S.	E.	W.		E.	W.	
						50. 6 — .23			6. 0 + .7
S. by W.	24		23.5		4.7	49.43 — .12		7.1	6. 7 + .43
W. S. W.	32		12.2		29.6	49.31 + .26		43.4	6.50 — .49
N. W. $\frac{1}{2}$ W.	41	26.0			31.7	49.57 — .44		48.7	7.39 — .32
S. S. E. $\frac{1}{4}$ E.	49		44.3	21.0		49.13 + .5	32.2		7. 7 — .32
E. N. E. $\frac{3}{4}$ E.	19	4.6		18.4		49.18 0.00	32.0		6.35 + .32
* W.	21				21.0	49.18 + .23		32.2	7. 7 — .43
N. E. $\frac{1}{2}$ E.	36	22.8		27.8		49.41 — .41	42.6		6.24 0
S.	41		41.0			49. 0 — 1.25			6.24 + .53
S. S. W.	92		85.0		35.2	47.35 + .36		53.0	7.17 0
N.	36	36.0				48 11			7.17
		89.4	206.0 89 4	67.2	122.2 67.2		106.8	184.4 106.8	
		Diff. Lat. 116.6		Dep 55.0			Di. Lon 77.6		

Hence it is plain, that the Ship has made of Southings 116.6, or 117 Miles, = $1^{\circ} 57'$, which being subtracted from the Latitude left $50^{\circ} 6'$, leaves $48^{\circ} 9'$ the Latitude in, and its differing 2 Miles from that in the Table is owing to the Tenths being so often omitted.

* This must be found by Middle Latitude Sailing.

104 M E R C A T O R ' s S A I L I N G .

The Meridian Distance or Departure is 55 Miles West, and the Difference of Longitude 77.6 or 78 Miles = $1^{\circ} 18'$ which being added to the Longitude left $6^{\circ} 0'$, gives $7^{\circ} 18'$ West, the Longitude in, nearly the same as in the Table.

Now to find the direct Course and Distance to the intended Port.
 From the Lat. in $48^{\circ} 9'$ Mer. Pts. $\left\{ \begin{array}{l} 3305 \\ 2333 \end{array} \right.$ From Long. in $7^{\circ} 18' W.$
 Take the Lat. Gibral. $36 12$ Take Lon. Gib. $4 53 W.$

<u>11 57</u>	Mer. Dif. Lat. <u>972</u>	<u>2 25</u>
60		60

Diff. of Lat.	<u>717 Miles.</u>	Diff. of Long.	<u>145 Miles.</u>
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As the Mer. Dif. of Lat. <u>972</u>	2.98767	As the S. Com. Cou. $8^{\circ} 29'$	9.99522
Is to Radius	10.00000	Is to the Diff. of Lat. <u>717</u>	2.85552
So is the Diff. of Long. <u>145</u>	2.16137	So is Radius	10.00000
	<u>12.16137</u>		<u>12.85552</u>
	2.98767		9.99522

To the T. of the Cou. $8^{\circ} 29'$	<u>9.17370</u>	To the Distance	<u>725 2.86030</u>
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Hence the direct Course to Gibraltar is S. $8^{\circ} 29'$ E. or S. $\frac{1}{4}$ E. nearly, and the Distance 725 Miles.

Now to find the Difference of Longitude by the first Rule, or that commonly used at Sea.

Lat. Land's End	<u>$50^{\circ} 6'$</u>	Merid. Parts $\left\{ \begin{array}{l} 3484 \\ 3305 \end{array} \right.$
Lat. in	<u>$48 9$</u>	

Diff. of Lat.	<u>$1 57$</u>	Mer. Diff. of Lat. <u>179</u>
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As the Diff. of Lat. <u>116.6</u>	2.06670	As S. Com. Cou. $25^{\circ} 15'$	9.95639
Is to Radius	10.00000	Is to the Mer. Dif. Lat. <u>179</u>	2.25285
So is the Departure <u>55</u>	1.74036	So is S. Course $25^{\circ} 15'$	9.62999
	<u>11.74036</u>		<u>11.88284</u>
	2.06670		9.95639

To the T. of the Cou. $25^{\circ} 15'$	<u>9.67366</u>	To the Diff. of Lon. $84 4$	<u>1.92645</u>
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Long. Land's End	<u>$6^{\circ} 0'$</u>
Diff. of Long. 84 , or	<u>$1 24$</u>

Longitude in	<u>$7 24$</u>	Nearly the same as before.
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Hence the Difference between the two Methods is 6 Miles, but as Ships never fail so far in 24 Hours, the last Method may be safely depended on for one Day's Run in Latitudes not exceeding 51 or 52 Degrees North or South, as may be seen by comparing the Results of the following Example.

Having

EXAMPLE.

Suppose a Ship from the Latitude $68^{\circ} 38' N.$ and Longitude $8^{\circ} 40' E.$ is bound to the North Cape in Latitude $71^{\circ} 27' N.$ and Longitude $26^{\circ} 30' E.$ fails as in the following Table; what Latitude and Longitude is she in, and her direct Course and Distance to the Cape?

Courses.	Diff.	N.	S.	E.	W.	Lats. in.	Diff. Long. E. W.
N. E. by N.	63	52.4		35.0		$69^{\circ} 30'$	97.2
N. E.	38	26.9		26.9		$69^{\circ} 57'$	78.0
N. N. E.	56	51.7		21.4		$70^{\circ} 49'$	64.0
N.	30	30.0				$71^{\circ} 19'$	
N. W. by N.	25	20.7			13.9	$71^{\circ} 40'$	44.0
N. N. W. $\frac{1}{2}$ W.	36	31.7			17.0	$72^{\circ} 12'$	5.0
N. by E.	40	39.2		7.8		$72^{\circ} 51'$	26.0
N. E. by E. $\frac{1}{2}$ E.	72	33.9		63.5		$73^{\circ} 25'$	219.4
S. E.	50		35.3	35.3		$72^{\circ} 50'$	120.6
E. N. E.	65	24.9		60.0		$73^{\circ} 15'$	207.0
		311.3	35.3	249.9	30.9		812.2
		35.3		30.9			99.0
Diff. Lat. =		276.1		219.0	Dep.	Diff. Lon.	713.2

With $\frac{1}{10}$ the Difference of Latitude and Departure, viz. 27.6, and 21.9, the Course is N. 38, 30 E. and Distance 353 Miles.

The Meridional Difference of Latitude is 852, with which and the direct Course $38^{\circ} 30'$, the Difference of Longitude is 676, being 37 Miles too little; a Quantity considerable enough to produce fatal Consequences.

Lat. left	$68^{\circ} 38' N.$	Long. left	$8^{\circ} 40' E.$
Diff. of Lat.	4 36 N.	Diff. Long.	11 53 E.
		Long. in	20 33 E.
Lat. in	73 14 N.	N. Cape's Long.	26 30 E.
Lat. of N. Cape.	71 27 N.		
		Diff. Long.	5 57 E.
Diff. of Lat.	1 47 N.	Or	357 Miles.
Or	107 Miles.		

Now to Meridional Difference of Latitude 353, and Difference of Longitude 357, the Course is S. $45^{\circ} 20' E.$ and to Course 45.20, and proper Difference of Latitude 107, the Distance is 152 Miles.

Hence the direct Course to the Cape is N. E. nearly and Distance 152 Miles.

Having gone through the necessary Problems, in *Mercator's Sailing*, we shall now proceed to shew how the true CHART, commonly called *Mercator's Chart*, may be constructed either for the Whole, or any Part of the Terraqueous Globe.

When a Chart is to commence from the Equator, or if the Equator is to run through it.

Having provided a Scale of convenient length, draw a Line to represent the Equator; and crossing that at Right Angles, another, to represent the Meridian of some known Place, such as *London*, *Paris*, the *Lizard*, or any other Place, whose Longitude is known; the upper End of which will represent the North, and the lower the South.

From the Scale take 60 in your Compasses, and with one Foot upon the Meridian, set off that Distance on both Sides of it upon the Equator, if the Chart is to contain East and West Longitude; but, if it is only to contain East or West Longitude, lay it off upon that Side of the Meridian the Case requires: That is, if the Longitude is to be Westward, lay it off on the left Hand Side of the Meridian; but if Easterly, the Right Hand Side.

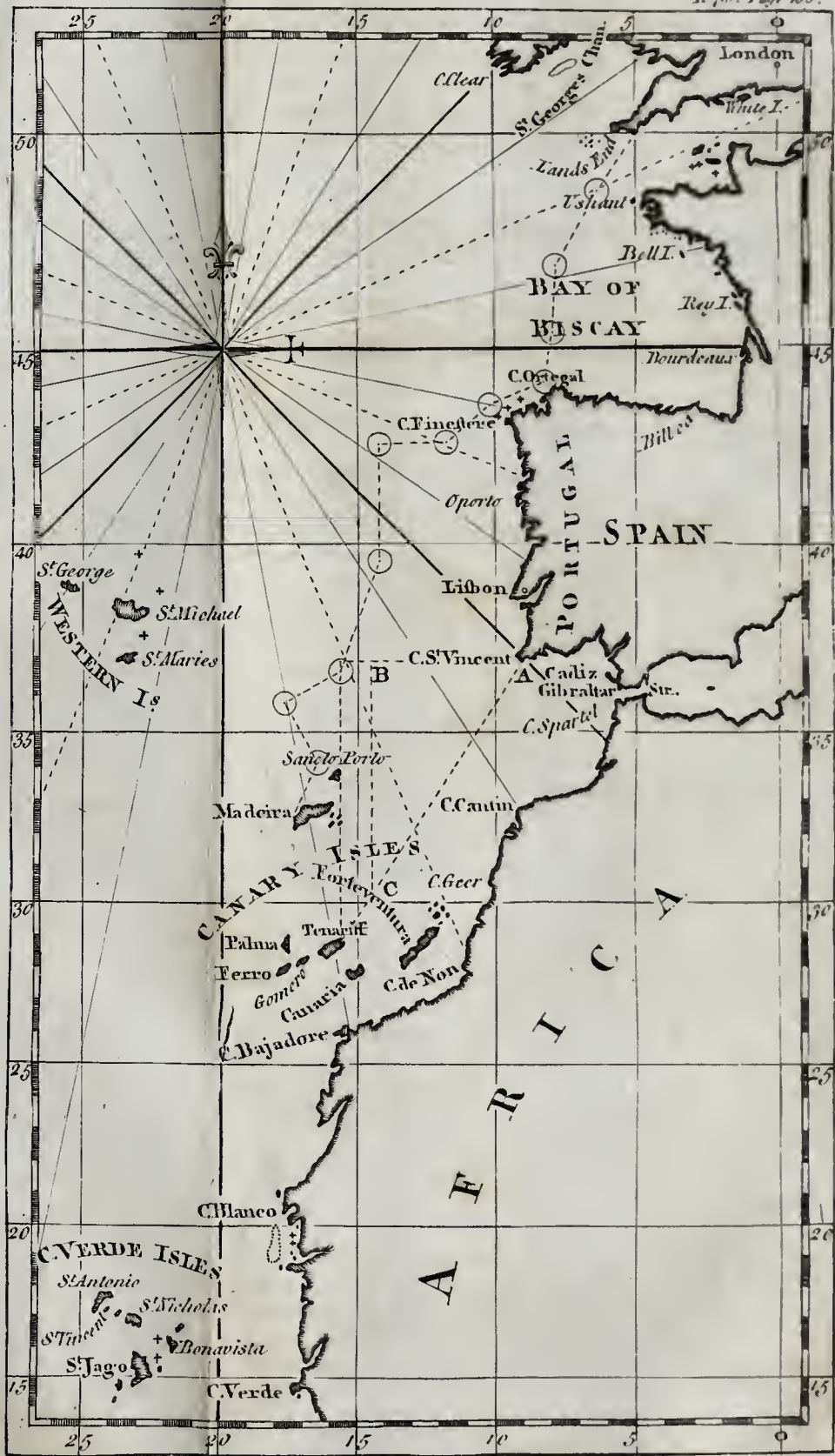
Again, take 2 Degrees or 120 Miles in your Compasses, and set it off from the Meridian, in the same Manner as before; or, with 60 Miles in the Compasses, turn over from the Meridian, and that will point out the Degrees of Longitude, which may be divided into Halves, Quarters, or Minutes, if required.

Having set off as many Degrees of Longitude as you intend the Chart should contain, through the last draw a Line (or Lines) parallel to the Meridian, which will be the Bounds of the Chart, East and West.

Having divided the Equator as above, proceed to set off upon the two extreme Meridians from the Equator, the Meridional Parts (as found in the Table) belonging to each Degree of Latitude; that is, take from the Scale in your Compasses, the Miles answering to one Degree in the Table, and with one Foot in the Equator, set off that Distance on each Side of it upon the extreme Meridians, if the Chart is to contain North and South Latitude; but if only North or South, upon one Side of the Equator. Again, take the Meridional Parts answering to 2 Degrees and 3 Degrees, &c. in your Compasses, and set them off upon the Meridian from the Equator, as before.

In like Manner proceed to set off as many Degrees as you intend the Chart should contain: Or, which will be the same Thing, take the Meridional Difference of Latitude between any two Parallels, and set them off severally from the least Latitude.

Lay a Ruler on each of these Divisions, and draw Lines parallel to the Equator, and they will be the Parallels of Latitude: each of which



which will be enlarged towards the Poles, in Proportion as the Degrees of Longitude are.

Parallel to the Meridian, draw Lines through the Points, expressing the Degrees of Longitude, to cut the Parallels of Latitude, which bound the Chart North and South.

The Parallels of Latitude may also be divided into Halves, Quarters, or Minutes, by taking the Meridional Parts for Degrees and Minutes, and setting them off as before.

Draw double Lines on the Borders of the Chart, and mark out the Degrees of Latitude and Longitude; and, in some convenient Place draw the Compass. In like Manner may a Chart be made that shall contain any Number of Degrees and Minutes required.

When the Chart is not to commence from the Equator, but is only to serve for a certain Distance on the Meridian, between two Parallels on the same Side of the Equator, then the Meridians are to be drawn as before; and for the Parallels of Latitude you are to proceed thus:

From the Meridional Parts answering to each Point of Latitude in your Chart, subtract the Meridional Parts answering to the least Latitude, and set off the Difference severally from the Parallels of the least Latitude upon the two extreme Meridians; and the Lines joining these Points of the Meridian will represent the several Parallels upon the Chart.

Let it be required to draw a Chart that shall serve from the Latitude of 14 Degrees North to 52 Degrees North, and that shall contain 1 Degree East, and 26 Degrees of Longitude West of the Meridian of *London*. See the Chart.

Draw a Line to represent the Meridian of *London*, from which set off 60 Miles towards the right Hand, for 1 Degree of Longitude; and on the other Side towards the left Hand, set off 26 Degrees of West Longitude, as before directed; through the two last Points draw Lines Parallel to the Meridian of *London*, and these will be the extreme Meridians, or East and West Bounds of your Chart.

Having drawn the two Meridians on the lower Edge of the Paper, draw a Line perpendicular to the Meridians, to represent the Parallel of 14 Degrees North; then from the Meridional Parts answering to 15 Degrees 910, subtract the Meridional Parts answering to 14 Degrees 848, and take the Difference 62 in your Compasses, and set it off from the Parallel on both the Meridians from you, and that will represent the Parallel of 15 Degrees.

Again, take the Meridional Parts of 15 Degrees 910, from the Meridional Parts of 16 Degrees 973, and set off the Difference 63, upon the Meridians from the Point representing the Parallel of 15 Degrees; and that will represent the Parallel of 16 Degrees. In like Manner proceed to set off the Parallels upon the Meridians.

Or, if the Meridional Parts of 14 Degrees be subtracted from the Meridional Parts of every succeeding Parallel, and the Difference be set off from the Parallel of 14 Degrees upon the Meridians, these Points will represent the several enlarged Parallels of Latitude, the same as before; and, if it be required that the Meridians should be divided into Degrees and Minutes, the Meridional Parts for such, must be taken from the Table, and set off as above.

Having set off as many Parallels as you intend the Chart should contain, through each Point draw Parallels, or if you think drawing Lines through every Degree will crowd your Chart too much, you may divide the Borders only, into single Degrees, &c. and draw Lines through every 5 Degrees of Latitude and Longitude, as in the Chart.

Take from the Table of Latitude and Longitude of Places, the Latitude and Longitude of each particular Place contained within the Bounds of the Chart, and lay a Ruler over its Latitude, and another, crossing that, over its Longitude, the Point where these cross will represent the proposed Place upon the Chart. In like Manner may any Place be readily marked. Hence, the particular Points of a Sea Coast being laid down as above, and Lines properly drawn from Point to Point, will form the Out-lines of the Sea Coasts, Islands, &c. to which may be annexed, the Depths of Water, Setting of Currents, and whatever else may be thought convenient for the Chart to contain.

This Map or Chart is not to be considered as a just or similar Representation of the Earth's Surface, for in it the Figures of Islands and Countries are distorted near the Poles. For,

Suppose an Island in the Latitude 60 N. or S. where the Breadth of a Degree of Longitude is just $\frac{1}{2}$ as large as a Degree upon the Equator. Now as the Degrees of Latitude are enlarged in Proportion as the Degrees of Longitude are expanded towards the Poles, it is plain that every Point of that Island or Country, being laid down in its proper Latitude and Longitude, will be represented twice as large as it really is.

Hence it follows, that as the Degrees of Latitude are every where increased as those of Longitude are, it is plain the Bearings between Places will be the same on this Chart as on the Globe; and the Proportions between the Latitude and Longitude, and Nautical Distances, will be the same upon this Chart as upon the Globe.

And since the Meridians in this Projection are Right Lines, it follows, that the Rhumbs which form equal Angles with the Meridians will be straight Lines, which renders this Projection of the Earth's Surface much more easy and proper for the Mariner's Use, than any other.

Gunter's Scales have drawn upon them 2 Lines, one marked M. R. signifying the Nautical Meridian; and the other directly under it marked E. P. signifying Equal Parts or Degrees of Longitude upon a *Mercator's Chart*.

Those

Those Equal Parts or Degrees of Longitude, to which the Degrees of the Nautical Meridian are fitted, by increasing them in their true Proportion; hence the Limits or Bounds of a *Mercator's Chart* by these Lines are easily made, by transferring the Divisions corresponding to the Degrees to be used, from the Scale to the Paper the Chart is to be drawn upon; but as the Degrees drawn by these Lines are too small for the Seaman's Use, it is much better to use a Scale of equal Parts as before, and consequently the Degrees may be made of any proposed Length.

By the Latitude and Longitude in, to prick off the Ship on the Chart.

RULE. Lay the Ruler across the CHART in the Latitude your Ship is in, then look upon the Equator, or Line marked with the Degrees of Longitude, for the Longitude your Ship is in by your Reckoning, and setting one foot of your Compasses in that Longitude, take the nearest Distance to some North and South Line, and from where that Line crosses the Edge of the Ruler that lies in the given Latitude; lay off that same Distance along the Edge of the Ruler to the Right Hand, if the Longitude you are in was to the Right Hand of the North and South Line, or to the Left Hand, if it was to the Left Hand; where this falls will be the Place of the Ship: But this will only do when the Longitude marked on the Chart, and your Reckoning of Longitude in, are both counted from the same Meridian. Therefore for a general Rule, take the following; viz.

By the Latitude in, and Longitude made, to prick off the Ship's Place.

RULE. Set one Foot of your Compasses in the Place you take your Departure from, and take the nearest Distance to some North or South Line, and from where that Line falls upon the Equator, or the Line marked with the Degrees of Longitude, set off that Distance the same Way the Place lies from it; that is, to the Right Hand, if the Place lies to the Right Hand of the North and South Line, or to the Left Hand, if it lies to the West; and make a Mark with a Black-lead Pencil; this Mark will serve to prick off by, till you come to take a new Departure: and then take and rub it out, and make a new one as before.

Then lay a Ruler across the Chart in the Latitude you are in, and taking so many Degrees in your Compasses from the Line of Longitude, as your Longitude made comes to, set them off from your Black-lead Mark along the Edge of the Ruler to the Eastward, if the Longitude made be East, or to the Westward, if it be West, where this falls will be the Longitude the Ship is in by the Chart; from which take the nearest Distance to some North and South Line, and from where that Line, &c. as in the first Case.

The

The Ship's Place on the Chart being found, as before taught, it remains in the next to shew how to find the Bearing and Distance of any Place from the Ship ; and first,

To find how any Place bears from the Ship.

RULE. Lay a Ruler from the Place of the Ship to the Place you would know the Bearing of ; then set one Foot of the Compasses in the Center of some Compass near the Ruler, and take the nearest Distance to the Edge of the Ruler ; then run one Foot of your Compasses along by the Edge of the Ruler ; and observing what Point of the Compass the other comes nearest to, which will be the Bearing required.

To find the Distance of any Place from the Ship.

C A S E I.

If the Place be in the same Longitude that the Ship is in, that is, if it bears due North or South, then the Difference of Latitude between them turned into Miles or Leagues, will be the Distance.

C A S E II.

If the Place be in the same Latitude the Ship is in, that is, if it bears due East, or due West ; then take Half the Distance between the Ship and the Place in your Compasses ; and setting one Foot on the Line marked with the *Degrees of Latitude*, in the Latitude the Ship is in, see what Latitudes the other Foot will reach to, both above and below it, the Difference between these two Latitudes will be the Distance required.

C A S E III.

When they are neither in the same Latitude nor in the same Longitude with the Ship..

RULE. Take the Difference of Latitude between both Places in your Compasses from the Equator, or graduated Parallel ; and laying a Ruler over both Places, put one Foot on the Ship's Place, and slide your Compasses along the Edge of the Ruler (holding both Points parallel to the Meridian) until the other cuts the Parallel of Latitude passing through the Place, (or E. and W. Line cut by the Ruler) and then stay the Compasses. Take the Distance between where the Point rested by the Edge of the Ruler and the Place (or where the Ruler crossed the aforefaid East and West Line,) in your Compasses, and apply it to
the

the Equator, or graduated Parallel, and that will give their Distance in Degrees, which may be turned into Miles or Leagues; and in the same Manner as you find the Bearing and Distance between the Ship and any Place, you may also find the Bearing and Distance of one Place from another.

EXAMPLE.

Required the Bearing and Distance between Cape St. Vincent and Teneriff.

Lay a Ruler over both Places, and take their Difference of Latitude $8^{\circ} 30'$, from the Equator or graduated Parallel, in your Compasses; and slide one Foot along the Edge of the Ruler from Teneriff (holding the other Point in the Direction of the Line C B) until the other Point just touches the East and West Line (A B) passing through St. Vincent, as at B, from C where the Foot of the Compasses rested, by the Edge of the Ruler, and St. Vincent being measured, and applied to the graduated Parallel, gives $10\frac{2}{3}$ Degrees, or 640 Miles the Distance.

Again, take the nearest Distance between the Center of the Compass in your Compasses, and sliding them along the Edge of the Ruler as before directed, you will find the Course to be S. W. by S. $\frac{1}{4}$ W. nearly.

Hence the direct Course between Cape St. Vincent and Teneriff is S. W. by S. $\frac{1}{4}$ W. Distance 640 Miles, or $213\frac{1}{3}$ Leagues; and the same with other Places.

O B L I Q U E S A I L I N G .

WE come next to the Doctrine of *Oblique Triangles* applied to Problems of Sailing; and though it may be applied to the measuring of inaccessible Objects, yet we shall confine it to those Problems which are more immediately necessary in Navigation; and is chiefly used in taking the Maps of Harbours, Sea-coasts, &c. as follows:

C A S E I .

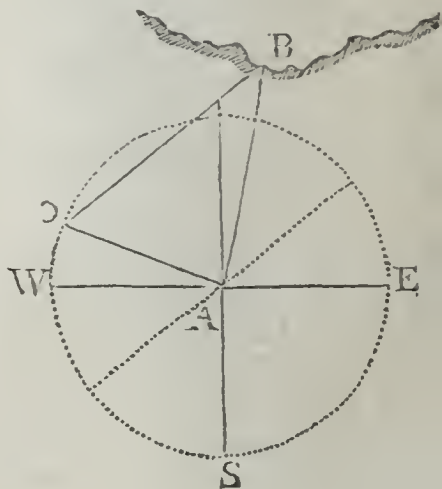
Coasting along the Shore, I saw a Cape of Land which bore from me N. by E. then I stood away W. N. W. 5 Leagues, or 15 Miles, and the same bore from me N. E. $\frac{1}{2}$ E. I demand the Distance of the Ship from the last Station to the Cape.

B Y P R O J E C T I O N .

Having drawn the Compass N. E. S. W. let A represent the Place of the Ship in her first Station, and draw the W. N. W. Line A C, equal to 15 Miles, then will C be the Place of the Ship in her second Station.

From C, draw the Line C B parallel to the N. E. $\frac{1}{2}$ E. Line, till it meets the N. by E. Line A B, in B; then will B represent the Cape of Land, and C B the Distance of the Ship at her second Station.

In the Triangle A B C, are given A C equal to 15 Miles; the Angle A $78^{\circ} 45'$ equal to 7 Points, the Distance between the N. by E. and W. N. W. the Angle B equal to $39^{\circ} 22'$ or $3\frac{1}{2}$ Points, the Distance between the N. by E. and N. E. $\frac{1}{2}$ E. and the Angle C equal to $61^{\circ} 53'$ or $5\frac{1}{2}$ Points, the Distance between the W. N. W. and S. W. $\frac{1}{2}$ W.



Whence to find the Distance CB, it will be,

As the Sine Angle B	---	39° 23'	9.80228
Is to the Side AC	---	15	1.17609
So is Sine Angle A	---	78° 45'	9.99157
			11.16766
			9.80228

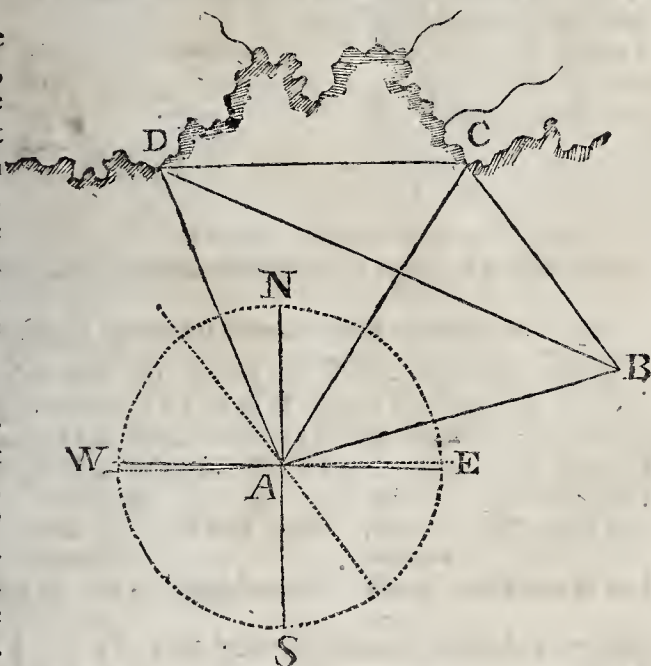
To the Side CB 23.19 the Distance of the Ship from
the Cape at her second Station } 1.36538

C A S E II.

Coasting along the Shore, I saw two Head-lands, the first bore N. N. W. the second N. N. E. $\frac{3}{4}$ Easterly, then standing away E. by N. $\frac{1}{2}$ Northerly, 16 Miles, the first bore from me W. N. W. the second N. W. by N. $\frac{1}{4}$ Westerly.

I demand the Distance of each of these Head-lands from the first Place, as also their Bearing and Distance from each other?

Having drawn the Compass as before, let A represent the Ship at her first place, from which draw the N. N. W. Line AD and the N. N. E. $\frac{3}{4}$ E. Line AC, and also the E. by N. $\frac{1}{2}$ N. Line AB, which make equal to 16 Miles, then B will represent the Ship at her second Place; from B draw BD parallel to the W. N. W. Line, and BC parallel to the N. W. by N. $\frac{1}{2}$ W.



Line, meeting the two first Lines in the Points C and D, then D will be the first, and C the second Head-land, join the Points D and C, and DC will be their Distance asunder. Then draw a Line parallel to DC through the Center of the Compass, and that will shew their Bearings from each other; to find which

BY CALCULATION.

To find the Distance of the first Head land.

In the Triangle DAB are given the Angle DAB $8\frac{1}{2}$ Points = $95^\circ 37'$, the Angle contained between the N. N. W. Side AD, and

P

E.

E. by N. $\frac{1}{2}$ N. Line AB, and the Angle ABD $3\frac{1}{2}$ Points = $39^{\circ} 22'$, the Angle contained between the E. by N. $\frac{1}{2}$ N. Line AB, and W. N. W. Line BD, and AB 16 Miles, whence by Axiom second it will be

As Sine Angle ADB	—	$45^{\circ} 1'$	9.84961
Is to the opposite Side AB	—	16	1.20412
So is Sine Angle ABD	—	$39^{\circ} 22'$	9.80228
			11.00640
			9.84961

To the Side AD 14.35 the Distance of the first Head-land 1.15679

To find the Distance of the second Head-land.

In the Triangle ABC are given, the Angle BAC $3\frac{1}{4} = 42^{\circ} 11'$, the Angle contained between the N. N. E. $\frac{3}{4}$ E. Line AC, and the E. by N. $\frac{1}{2}$ N. Line AB, and the Angle ABC $6\frac{1}{4}$ Points = $70^{\circ} 19'$, the Angle contained between the E. by N. $\frac{1}{2}$ N. Line AB, and the N. W. by N. $\frac{1}{4}$ W. Line BC, and the Side AB 16 Miles, whence by Axiom second it will be,

As Sine Angle ACB	—	$67^{\circ} 30'$	9.96561
Is to the Side AB	—	16	1.20412
So is Sine Angle ABC	—	$70^{\circ} 19'$	9.97385
			11.17797
			9.96561

To the Side AC 16.31 the Distance of the second Head-land 1.21236

To find the Bearing and Distance of the Head-lands.

In the Triangle DAC are given, the Side AC 16.31, the Side AD 14.35, and the Angle DAC $4\frac{3}{4}$ Points = $53^{\circ} 26'$, the Angle contained between the N. N. W. Line AD, and the N. N. E. $\frac{3}{4}$ E. Line AC, whence to find the Angles ADC, or ACD.

The Side AC	16.31	Ang. DAC	$180^{\circ} 00'$	
The Side AD	14.35		$53^{\circ} 26'$	
Sum of the Sides	<u>30.66</u>	Sum Angles	<u>126</u>	<u>34</u> opposite the Sides.
Difference of Sides	<u>1.96</u>	half Sum of ditto	<u>63</u>	<u>17</u> { then by Axiom
				third it will be
As the Sum of the Sides AC and AD	—	30.66		1.48657
Is to their Difference	—	1.96		0.29226
So is T. of $\frac{1}{2}$ the Sum of Angles ADC and ACD		$63^{\circ} 17'$		10.29816
				10.59042
				1.48657
To the Tangent of half their Difference		$7^{\circ} 14'$		9.10385

Then $63^{\circ} 17'$ added to $7^{\circ} 14'$ is $70^{\circ} 31'$, the greater Angle ADC, and $63^{\circ} 17' - 7^{\circ} 14' = 56^{\circ} 3'$ the Angle ACD.

Now the Angle ADC $70^{\circ} 31'$ added to $22^{\circ} 30'$, the Angle contained between the N. N. W. Line AD, and the Meridian gives $93^{\circ} 1'$, which being more than a Right-Angle, shews that D bears from C, W. $3^{\circ} 1'$ fouthery, and consequently C bears from D East $3^{\circ} 1'$ northerly.

For the Distance it will be by AXIOM II.

As the Sine of the Angle ADC = $70^{\circ} 31'$	—	9.97439
Is to the Side AC	— 16.31 —	1.21245
So is Sine Angle DAC	— $53^{\circ} 26'$ —	9.90480
		11.11725
		9.97439

To the Side DC 13.9, the Distance between the Head-land 1.14286

All the above Proportions may be worked by Gunter's Scale, but they are more readily done by Projection.

After this Manner may the mutual Bearings and Distances of any Number of Head-lands be found; as also the Maps of Harbours, Sea Coasts, &c. which are of excellent Use in reconnoitering the Enemy's Coasts, Towns, &c. without venturing too near their Ports. Many more Examples might be produced, which are not of much Use at Sea, and therefore are omitted.

There is a Method of ascertaining the Distances of Places by Sound, which is as follows: Fix a Pendulum of 38.2 Inches upon a Peg or Nail, and giving it a swing, every Time it passes the Center will give Seconds; and as it is found by many Experiments, that Sound travels 1142 Feet in one Second; therefore the Difference of Time between seeing the Flash and hearing the Sound being measured by the Pendulum, the Distance may be easily found by allowing 1142 Feet for every Second, or allowing $9 \frac{1}{4}$ Half Seconds to travel an English Mile, or five Seconds three tenths to travel a Geographical Mile.

E X A M P L E.

Being at Sea, I counted 50 Seconds between the Time of seeing the Flash of a Gun, and hearing the Report. I demand the Distance?

If 50 Seconds be divided by 5.3, the Quotient 9.3 Miles, will be the Distance required; or if the same Number of Seconds, viz. 50, be divided by 16, the Quotient $3 \frac{1}{8}$ Leagues, will give the Leagues of Distance, so that the Gun, when it was fired, was 9.4 Miles, or 3 Leagues and one eighth from the Observer.

CURRENT SAILING.

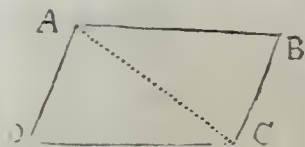
CURRENTS are certain Settings of the Stream, by the Means of which, all bodies moving therein, are compelled to alter their Course, and submit to the Motion impressed upon them by it.

Whence, if a Current sets with the Course of the Ship, it augments her Motion by as much as the Drift or Rate of Driving is.

Thus, if a Ship sails N. N. E. 20 Miles in a Current that sets N. N. E. 8 Miles in the same Time, her true Course will be N. N. E. 28 Miles in that time; but if a current sets against the Ship, it lessens her Velocity by just so much as the Current's Drift is.

So that if a Ship sails N. E. 49 Miles, in a Current that sets S. W. 10 Miles in the same Time, then her true Course will be N. E. 39 Miles; and if, in the same Time that the Ship sails N. E. 49 Miles, in a Current that sets S. W. 59, then the Ship will fall a-stern, and her true Course will be S. W. 10 Miles; but if the Ship thwarts the Current, it not only lessens or augments her Velocity, but gives her a new Motion compounded of that of the Ship and Current; that is,

If a Body be agitated by two Motions at the same Time, the one with a certain Velocity, that will carry it according to the Direction of the Line AB , the Length AB in a certain Space of Time; the other according to the Direction of the Line AD , with a Velocity that will carry it to the Distance AD , in the same Time; then the Body will describe the Diagonal AC , and at the End of that Time, will be found in the Point C .



The Setting and Drift of the most remarkable Tides and Currents are pretty well known; but, if in unknown Currents, the usual Way to find the Setting and Drift, is thus:

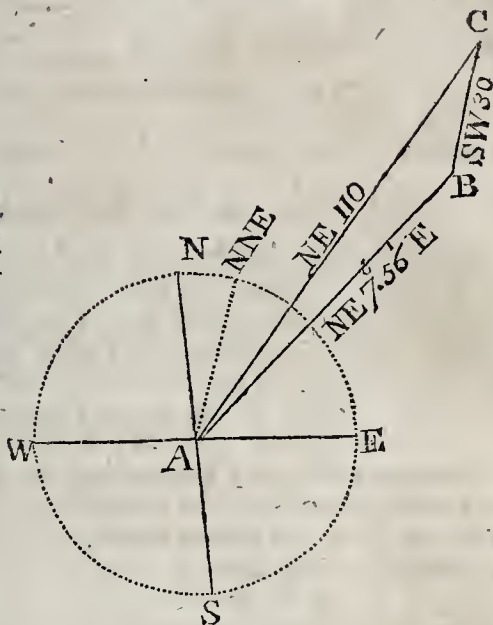
Let three or four men take a Boat a little Way from the Ship, and by a Rope fastened to the Boat's Stem, let down a heavy Iron Pot, or loaded Kettle, into the Sea to the Depth of 80 or 100 Fathoms, when it can be, whereby the Boat will ride almost as steady as at Anchor; then heave the Log, and the Number of Knots run out in Half a Minute, will give the Miles which the Current runs per Hour, and the Bearing of the Log shews the Setting of the Current.

E P A M P L E I.

If a Ship sails N. E. 110 Miles in a Current that sets S. S. W. 30 Miles in the same Time, and her true Course and Distance be required?

BY PROJECTION

Set off 4 Points from N. towards E. and Draw AC equal to 110 Miles; from C draw CB parallel to the N. N. E. Line, and equal to 30 Miles draw AB, which will be the Ship's true Course.



BY CALCULATION.

In the Triangle ABC are given the Side AC 110, the Side BC 30 Miles, and the Angle ACB $22^{\circ} 30'$.

The Side AC	110	$180^{\circ} 0'$
CB	30	$22 30$

The Sum of the Sides 140 the Sum of Anf. A & B 157 30 opp. these Sides.

Their Difference $80 \frac{1}{2}$ the Sum of the Anf. 78 45 CAB and ABC.

As the Sum of the Sides AC and AB 140 2.14613
Is to their Difference 80 1.90309
So is the T. of $\frac{1}{2}$ the Sum of Ang. CBA and BAC $78^{\circ} 45'$ 10.70134

12.60443
2.14613

To the Tangent of Half their Difference $70^{\circ} 49'$ 10.45830

Half the Sum of the Angles CAB and CBA $78^{\circ} 45'$
Half their Difference 70 49

Which being added gives the greatest Angle CBA 149 34

But if subtracted, the lesser CAB 7 56

Hence it appears that the Course is N. E. $7^{\circ} 56'$ Easterly.

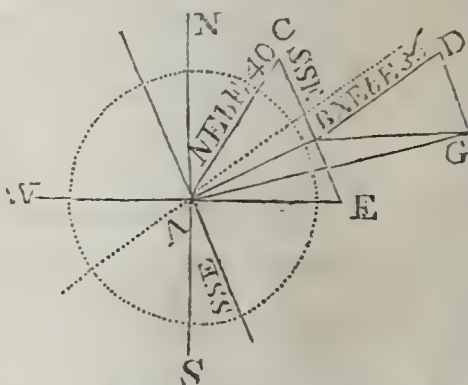
As Sine Angle B	149.34	—	—	9.70461
Is to the Side AC	110	—	—	2.04139
So is Sine Angle C	22° 30'	—	—	9.58284
				11.62423
				9.70461
To the Distance run	83° 2'	—	—	1.91962

E X A M P L E II.

If a Ship from the Latitude 36° 30' S. fails N. E. by N. 40, then N. E. by E. 36 Miles, in a Current that sets S. S. E. 20 Miles, in the same Time that the Ship fails 38 Miles; and it be required to find the Distance between the Ship and her first Place, as also the Latitude the Ship is in?

BY PROJECTION.

Having drawn the Compass, as before, draw the N. E. by N. Line equal to 40 Miles; upon the End of which draw a Line parallel to the S. S. E. upon which set off 21 Miles, the Distance the Current sets while the Ship runs 40 Miles; then draw the N. E. by E. Line, upon which set off 36 Miles, at the End of that, draw the S. S. E. Line, on which set off 18.9 Miles, the Distance the Current sets while the Ship runs 36 Miles; then from the End of that Line to the Ship's first Place, will be the Distance; and the Angle, being measured, will be the Ship's Course, and a Line drawn from the Ship's last Place, parallel to the E. and W. till it cuts the Meridian; that being measured from the Ship's first Place will be the Miles of Difference of Latitude.



This may be done by Calculation, but it being tedious, we shall omit it, and shew how it may be done by a Traverse, in which we shall consider the CURRENT as a single Course.

Courses	Dist.	Differ. of Latitude.		Departure	
		North.	South.	East.	West
N. E. by N.	40	33.3		22.2	
N. E. by E.	36	20.0		29.9	
S. S. E.	40		37.0	15.3	
		53.3		67.4	Departure
		37.0			
Differ. of Latitude		16.3			

Having the Diff. of Lat. and Dep. to find the Course and Distance.

As the Diff. of Lat. 16 3	1.21219	As the S. Course $76^{\circ} 24'$	9.98765
Is to Radius	10.00000	Is to the Departure 67.4	1.82866
So is the Depart. 67.4	1.82866	So is Radius	10.00000
	<u>11.82166</u>		<u>11.82866</u>
	1.21219		9.98765
To T. of the Cou. $76^{\circ} 24'$	<u>10.61647</u>	To the Distance 69.3	<u>1.84101</u>

E X A M P L E III.

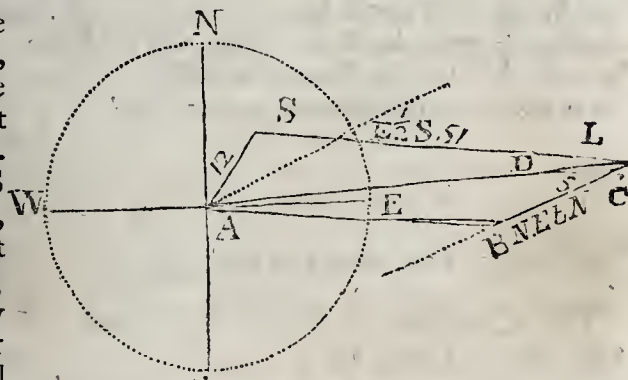
A Ship coming out from Sea in the Night, has Sight of Scilly Light, bearing N. E. by N. Distance 4 Leagues; it being then Flood Tide, setting E. N. E. 2 Miles an Hour, and the Ship running at the Rate of 5 Knots an Hour; I demand upon what Course she must steer, and how far, to hit the Lizard, it bearing from Scilly E. $\frac{1}{2}$ S. Distance 17 Leagues?

BY PROJECTION.

Having drawn the Compass as before, let A represent the Place of the Ship at Sea, and draw the N. E. by N. Line AS equal to 12 Miles, then will S represent Scilly.

2dly. From S. draw SL equal to 51 Miles, and parallel to the E. $\frac{1}{2}$ S. Line, then will L be the Place of the Lizard.

3dly. Draw LC parallel to the W. S. W. Line equal to 2 Miles, and CD equal to 5 Miles; and parallel to it, draw AB till it meets LC produced in B, then will AB be the Distance required, and the Angle S A B the true Course.



BY CALCULATION.

In the Triangle ASL are given AS equal to 12 Miles, SL equal to 51 Miles, and the Angle ASL $118^{\circ} 7'$ equal to $10\frac{1}{2}$ Points, the Distance between the N. E. by N. and W. $\frac{1}{2}$ N. whence to find the Angle SAL, it will be,

As the Sum of the two Sides AS and SL 63	1.79934
Is to their Difference 39	1.59106
So is Tan. of Half the Angles S A L and S L A $30^{\circ} 56'$	9.77763
	<u>11.36869</u>
	1.79934
To the Tan. of Half their Difference	<u>20^{\circ} 21'</u> 9.56935

Whence the Angle SAL will be found $=$ to $51^{\circ} 17'$, and consequently the direct Course from the Ship to the Lizard is $N. 85^{\circ} 2' E.$ or $E.$ by $N. 6^{\circ} 17'$ Easterly.

To find the Distance AL it will be,

As the Sine Angle at SAL $51^{\circ} 17'$	—	9.89223
Is to the Distance from Seilly to the Lizard 51		1.70757
So is the Sine of the Angle ASL $118^{\circ} 7'$	—	9.94546
		11.65303
		9.89223

To the Distance between the Ship and Lizard 57.65	1.76080
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In the Triangle DLC are given the Angle $L = 17^{\circ} 32'$, the Distance between the $E. N. E.$ and the $N. 85^{\circ} 2' E.$ The Side CL , the Current's Drift in an Hour $= 2$ Miles, and the Side CD , the Ship's Distance run in that Time, $= 5$ Miles; whence to find the Angle at D , it will be,

As the Distance run in one Hour CD 5 Miles	—	0.69897
Is to the Drift of the Current 2 Miles		0.30103
So is the Sine of the Angle at L $17^{\circ} 32'$		9.47894
		9.77997
		0.69897

To the Sine of the Angle at D $6^{\circ} 55'$	9.08100
---	---------------

Hence, because the Angle CDL is $= BAL$ the Course the Ship must steer is $S. 88^{\circ} 33' E.$

To find the Distance AB , it will be,

As the Sine Angle at B $153^{\circ} 33'$		9.61689
Is to the Distance between the Ship and Lizard 57.65		1.76080
So is the Sine of the Angle at L $17^{\circ} 32'$		9.47894
		11.23974
		5.61689

To AB the Distance she must sail 41.96	1.62285
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Many more Questions might be added, but these, being well understood, are sufficient for the Seaman's Purpose; and that the Student should not meet with any Thing unnecessary which might lead him out of the plain Path, I have avoided those Things which tend to puzzle more than improve; therefore would advise him to be well acquainted with every written Article; and that nothing may be wanting to complete the Artist, I shall proceed to the Rules necessary for keeping a *Journal at Sea*.

O F W I N D S.

THE Sun, that amazing Globe of Fire, the Fountain of Light, and Heat of the whole solar System, whose Rays upon the Earth cause Vapours or Fumes to be continually rising from it, which must partake of the Quality of those Parts from whence they are evaporated; a Collection of which form what we call our Air or Atmosphere, surrounding the Earth and extending some Miles above its Surface; and is liable to be put in Motion by various Causes. Hence Air is a fine elastic Fluid, and is found capable of being compressed, or condensed by Cold, and expanded or rarefied by Heat.

Consequently, an Alteration of Heat or Cold happening in any Part of the Atmosphere, the Air in that Part will be either condensed or rarefied, and the neighbouring Parts will thereby be put into Motion, through the Endeavour which the Air, by its Elasticity or Springiness always makes to restore itself to its former State, or come to an Equilibrium.

Wind is a Stream or Current of Air, which generally blows from one Part of the Horizon to its opposite Part.

The following Observations have been made on it, particularly by Dr. Halley, which are not unworthy the Seamen's Notice.

Between 30 Degrees North Latitude, and 30 South Latitude, there is a constant East Wind throughout the Year, blowing on the Atlantic and Pacific Oceans, and this is called the Trade Winds.

For as the Sun, in moving from East to West, heats the Air more immediately under him, and thereby expands it; the Air to the Eastward is constantly rushing towards the West to restore the Equilibrium, or natural State of the Atmosphere, which occasions a perpetual West Wind in those Limits.

The Trade Winds near these Northern Limits, blow between the North and East, and near the southern Limits they blow between the South and East.

For as the Air is expanded by the Heat of the Sun near the Equator, therefore the Air from the Northward and Southward will both tend toward the Equator to restore the Equilibrium: now these Motions from the North and South, joined with the foregoing easterly Motion, will produce the Motions observed near those Limits between the North and East, and between the South and West.

These Winds, if the whole Surface of the Globe were Sea, would undoubtedly blow quite round it, as they are found to do in the Atlantic and Ethiopic Oceans; but seeing such great Continents interpose and break the Continuity of the Ocean, regard must be

had to the Nature of Soils, and the Position of high Mountains, which are the principle Causes of the Variety of Winds differing from the former general one.

In some Parts of the Indian Ocean there are periodical Winds, which are called Monsoons; that is, such as blow half the Year one Way, and the other Half-year the contrary Way.

For Air that is cool and dense will force the warm and rarefied Air in a continual Stream upwards, where it must spread itself to preserve the Equilibrium; so that the upper Course or Current of the Air shall be contrary to the under Current; for the upper Air must move from those Parts where the greatest Heat is, and so by a kind of Circulation, the N. E. Trade Wind below, will be attended with a S. W. above; and a S. E. below with a N. W. above. And this is confirmed by the Experience of Seamen, who, as soon as they get out of the Trade Winds, immediately find a Wind blowing from the opposite Quarter.

In the Atlantic Ocean, near the Coasts of Africa, at about 100 Leagues from Shore, between the Latitudes of 28° and 10° North, Seamen constantly meet with a fresh Gale of Wind blowing from the N. E.

Those bound to the Caribbee Islands, across the Atlantic, find, as they approach the American Side, that the said N. E. Wind becomes Easterly, or seldom blows more than a Point from the East either to the Northward or Southward.

These Trade Winds on the American Side, are extended to 30° , 31° , or even to 32° of North Latitude; which is about 4° farther than what they extend to on the African Side; also to the Southward of the Equator, the Trade Winds extend 3 or 4 Degrees farther towards the Coast of Brazil on the American Side, than they do near the Cape of Good Hope on the African Side.

Between the Latitudes of 4 Degrees North, and 4 South, the Wind always blows between the South and East: On the African Side the Winds are nearest the South, and on the American Side nearest the East. In these Seas Dr. Halley observed, that when the Wind was Eastward, the Weather was gloomy, dark, and rainy, with hard Gales of Wind; but when the Wind veered to the Southward, the Weather generally become serene, with gentle Breezes next to a Calm.

These Winds are somewhat changed by the Seasons of the Year; for when the Sun is far Northward, the Brazil S. E. Wind gets to the South, and the N. E. Wind to the East; and when the Sun is far South, the S. E. Wind gets to the East, and the N. E. Wind on this Side of the Equator veer more to the North.

Along the Coast of Guinea, from Sierra Leone to the Island of St. Thomas under the Equator, which is above 500 Leagues, the Southerly and South-west Winds blow perpetually; for the S. E. Trade

Trade Wind having passed the Equator, and approaching the Guinea Coast within 80 or 100 Leagues, inclines towards the Shore, and becomes S. S. E. then South, and by Degrees as it comes near the Land, it veers about to S. S. W. and in with the Land it is S. W. and sometimes W. S. W. This tract is troubled with frequent Calms, and violent sudden Gusts of Wind, called Tornados, blowing from all Points of the Horizon.

The Reason of the Wind setting in West on the Coast of Guinea is, in all Probability, owing to the Nature of the Coast, which being greatly heated by the Sun, rarefies the Air exceedingly, and consequently the cool Air from off the Sea will keep rushing in to restore the Equilibrium.

Between the 4th and 10th Degrees of North Latitude, and between the Longitudes of Cape Verd, and the eastermost of the Cape Verd Islands, there is a Tract of Sea which seems to be condemned to perpetual Calms, attended with terrible Thunder and Lightnings, and such frequent Rains, that this Part of the Sea is called the Rains. Ships in sailing these 6 Degrees have been sometimes detained whole Months, as it is reported.

The Cause of this seems to be, that the Westerly Winds setting in on this Coast, and meeting the general Easterly Wind in this Tract; balance each other, and so cause the Calms, and the Vapours carried thither by each Wind meeting and condensing, occasion the almost constant Rains.

The last three Observations shew the Reason of the two following, which Mariners experience in sailing from Europe to India, and in the Guinea Trade. The Difficulty which Ships in going to the Southward, especially in the Months of July and August, find in passing between the Coast of Guinea and the Brazil, notwithstanding the Width of this Sea is more than 500 Leagues: This happens because the S. E. Winds, at that Time of the Year, commonly extend some Degrees beyond the ordinary Limits of 4° N. Latitude; and besides coming so much Southerly, as to be sometimes South, sometimes a Point or two to the West, it then only remains to ply to Windward. And if on the one Side they steer W. S. W. they get a Wind more and more Easterly; but then there is Danger of falling in with the Brazilian Coast, or Shoals; and if they steer E. S. E. they fall into the Neighbourhood of the Coast of Guinea, from whence they cannot depart without running Easterly as far as the Island of St. Thomas, and this is the constant Practice of all the Guinea Ships.

All Ships departing from Guinea for Europe, their direct Course is Northward; but on this Course they cannot go, because the Coast bending nearly East and West, the Land is to the Northward; therefore as the Winds on this Coast are generally between the S. and W. S. W. they are obliged to steer S. S. E. or South, and with these Courses they run off the Shore; but in so doing they

always find the Wind more and more contrary, so that when near the Shore they can lie South; at a great Distance they can make no better than S. E. and afterwards E. S. E. with which Courses they generally fetch the Island of St. Thomas and Cape Lopez, where finding the Winds to the Eastward of the South, they sail W. orly with it, till coming to the Latitude of 4 Degrees South, where they find the S. E. Wind blowing perpetually.

On Account of these general Winds all those that use the West India Trade, even those bound to Virginia, reckon it their best Course to get as soon as they can to the Southward, that so they may be certain of a fair and a fresh Gale to run before it to the Westward; and for the same Reason those homeward bound from America endeavour to gain the Latitude of 30 Degrees, where they first find the Wind begin to be variable; though the most ordinary Winds in the North Atlantic Ocean come between the South and West.

Between the Southern Latitudes of 10 and 30 Degrees in the Indian Ocean, the general Trade Wind about S. E. by S. is found to blow all the Year round in the same Manner as in the like Latitudes in the Ethiopic Ocean, and during the Six Months, from May to December, these Winds reach to within 2 Degrees of the Equator; but during the other Six Months, from November to June, a N. W. Wind blows in the Track lying between the 3d and 10th Degrees of Southern Latitude, in the Meridian of the North End of Madagascar; and between the 2d and 12th Degree of South Latitude, near the Longitude of Sumatra and Java.

In the Track between Sumatra and the African Coast, and from 3 Degrees of South Latitude quite Northward to the Asiatic Coasts, including the Arabian Sea and the Gulph of Bengal, the Monsoons blow from September to April on the N. E. and from March to October on the S. W. In the former Half-year the Wind is more steady and gentle; and the Weather clearer than in the latter six Months, and the Wind is more strong and steady in the Arabian Sea than in the Gulf of Bengal.

Between the Island of Madagascar and the Coast of Africa, and thence Northward as far as the Equator, there is a Tract wherein, from April to October, there is a constant fresh S. S. W. Wind, which to the Northward changes into the W. S. W. Wind blowing at that Time in the Arabian Sea.

To the Eastward of Sumatra and Malacca, on the North of the Equator, and along the Coasts of Cambodia and China, quite through the Philippines as far as Japan, the Monsoons blow Northerly and Southerly; the Northern setting in about October or November, and Southern about May. These Winds are not quite so certain as those in the Arabian Sea.

Between Sumatra and Java to the West, and New Guinea to the East, the same Northerly and Southerly Winds are observed; but the first Half-year the Monsoon inclines to the N. W. and the latter

latter to the S. E. These Winds begin a Month or six Weeks after those in the Chinese Seas set in, and are quite as variable.

These contrary Winds do not shift from one Point to its opposite all at once; in some Places the Time of the Change is attended with Calms, in others by variable Winds; and it often happens on the Shores of Coromandel and China, towards the End of the Monsoon, that there are most violent Storms, greatly resembling the Hurricanes in the West Indies, wherein the Wind is so vastly strong that hardly any thing can resist its Force.

All Navigation in the Indian Ocean must necessarily be regulated by these Winds; for if Mariners should delay their Voyages till the contrary Monsoon begins, they must either sail back, or go into Harbour, and wait for the returning of the Trade Wind.

Vapours rising from the Sea, and by the Wind carried over low Lands to the ridges of Mountains, and compelled to mount up with the Stream of the Air to the Tops, where the water presently precipitates, gleeing down by the Chinks and Cliffs of the Stones, and Part of the Water entering into the Caverns of Hills, and gathering into Basins, which being once filled begin to run over, and form subterraneous Passages through the Earth, breaking out in Springs by the Sides of Hills: several of these meeting together form Rivulets; several of these Rivulets meeting together make a River. This, together with what is incorporated into Vegetables, renders it impossible for all the Water evaporated from the Sea to return to it again.

Hence the Evaporations arising from the Mediterranean are such, that notwithstanding there are Nine capital Rivers which empty themselves into it, besides smaller ones, there is a constant current running through the Straits of Gibraltar from the Atlantic Ocean to make up the Deficiency. R. Mead, M.D. and F.R.S. observes, 1. That some Diseases are properly the Effects of the Influence of the heavenly Bodies. 2. That the most windy Seasons of the Year, are about the vernal and autumnal Equinoxes. 3. All the Changes we have enumerated in the Atmosphere do fall out at the same Times when those happen in the Ocean; and, as both the Waters of the Sea and the Air of our Earth are Fluids, subject in a great Measure to the same Laws of Motion, so that natural Effects of the same Kind are owing to the same Causes. 4. The Alteration made by the Sun and Moon in the Atmosphere must thereby have Influence on the Animal Body. 5. The Elasticity of the Air is of great Moment, and it is reciprocally as the Pressure, so that the incumbent Weight being diminished by the Attraction, the Air underneath will be much expanded: these, and such like Causes, will make the Tides in the Air to be much greater than those of the Ocean; and there is no doubt to be made, but that the same infinite wise Being, who contrived the Flux and Reflux of the Seas, to secure that vast Collection of Waters from Stagnation and Corruption,

ruption, has ordered this Ebb and Flood of the Air of our Atmosphere with the like good Design; that is, to preserve it sweet, and a brisk Temper of this Fluid so necessary to Life, by a continual Circulation. 6. Two contrary Winds blowing towards the same Place, may accumulate the Air there so as to increase the Height and the Weight of the incumbent Cylinder; in like Manner the Direction of two Winds may be such, as meeting at certain Angles, may keep the Gravity of the Air in a middle State; but if the Winds blow different Ways from the same Place (which may be occasioned by Thunder and Lightning), the Height and Weight of the Air may be much decreased. 7. The Changes in our Atmosphere at High Water, New and Full Moon, the Equinoxes, &c. must occasion Alterations in all animal Bodies, for all living Creatures require Air of a determined Gravity to perform Respiration easily, for it is by its Weight that this Fluid insinuates itself into the Cavity of the Breast and Lungs: by a slow Circulation the Secretion of the Spirits is diminished; and, by the Want of Force of Elasticity and Gravity, the Juices begin to ferment, change the Union of the Parts, break their Canals, and Diseases follow.

Besides the above Causes, the Atmosphere may be put in Motion by the elastic Vapours forced from the Bowels of the Earth by subterraneous Heats, and condensed by whatever Cause in the Atmosphere. A Mixture of Effluvia of different Qualities in the Air, may by Rarefaction, Fermentation, &c. produce Winds and other Effects like those resulting from the Combination of some chymical Liquors; and that such things happen, we are assured from the Nature of Thunder, Lightning, and Meteors. From the Eruptions of Vulcanoes and Earthquakes, in distant Places, Winds may be propagated to remoter Countries. The divided or united Forces of the other Planets, and of the Comets, may variously disturb the Influence of the Sun and Moon, &c. We know that there happen violent Tempests in the upper Regions of the Air when we below enjoy a Calm, and how many Ridges of Mountains there are on our Globe which interrupt and check the Propagation of the Winds, so that it is no wonder that the Phænomena we have ascribed to the Action of the Sun and Moon are not always constant and uniform, and that every Effect does not hereupon follow; which, were there no other Powers in Nature able to alter the Influence of this, might in a very regular and uniform Manner be expected from it.

NOTE. The Swiftness of Wind in a great Storm is not more than 50 or 60 Miles in an Hour, and a common brisk Gale is about 15 Miles an Hour.

O F T I D E S.

THE Tides, or the Flux and Reflux of the Sea, is that regular Motion of the Waters by which they rise and fall at certain equal Intervals of Time.

The Doctrine of Tides remained in Obscurity, till the immortal Sir Isaac Newton explained it by his great Principle of Gravity and Attraction. For having demonstrated that there is a principle in all Bodies within the Solar System, by which they mutually attract each other in Proportion to the Squares of their Distances, it follows, that those Parts of the Sea which are immediately under the Moon must be drawn towards it, and consequently whenever the Moon is nearly vertical the Sea will be raised, which occasions the flowing of the Tide there.

By the Earth's diurnal Rotation from West to East in 24 Hours, the Sun apparently revolves from East to West in the same Time; so by the same Rotation, the Moon apparently revolves from East to West in the Space of 24 Hours 49 Minutes, commonly called 2 Lunar Day, so as in that Time to return to the Meridian she set out at; and as the Sun apparently moves round the Earth in a Year, so the Moon really moves round it in about $29\frac{1}{2}$ Days; consequently, if the Sun and the Moon are both upon the Meridian at any Time, it will be 29 Days and an Half before they are upon the same Meridian again, or in Conjunction, and about Half that Time, viz. 14 Hours 18 Minutes before they are upon opposite Meridians, or in Opposition. Now, as the Sun attracts the Earth, though much less than the Moon, being at so vast a Distance from it, yet when they are both upon the Meridian either in Opposition or in Conjunction, that is, at Full and Change, their joint Attraction conspire to raise the Tides higher than when they act cross-ways. Hence the Tides are higher than ordinary twice every Month, and are called Spring Tides; but this does not happen till two or three Days after, when the Attractions of the Sun and Moon have been united some Time. But when the Sun and the Moon act cross-ways, or are 90° asunder, the Tides are lessened in Proportion to the Difference of their Powers of Attraction, and produce what we call Neap Tides, which happen soon after the first and last Quarter of the Moon, when the Sun has lessened the Attraction of the Moon for some Time.

The Moon being the principal Cause of raising the Tides, they are always found to follow her, and consequently must always be shifting from West to East as the Moon does, so that if it is High Water at any Place when the Moon is upon the Meridian of that Place at Full or Change, it will be about 49 Minutes later on the following Day, 1 Hour 38 Minutes later on the second Day, falling back 49 Minutes every 24 Hours, until the Moon comes to the opposite Meridian; and then it will be High Water again. These
Tides

Tides regularly rise and fall twice in the 24 Hours, wherefore by knowing the Time of the Moon's southing at any Place, and the Time of High Water at Full or Change at that Place, we can find the Time of High Water on any other Day at the same Place, by allowing 49 Minutes later for every Day since the Full or Change, or 24 Minutes later for every Tide.

These Tides would be regular from West to East were the whole Earth covered with deep Water, but seeing their Course is obstructed by Land lying in their Way, surrounding Islands, running up winding Rivers, and otherwise affected by Shoals, striking against Capes and Head-lands; they are often forced to take long Circuits and various Directions to come to the Levels: that the Setting of the Tides and Times of High Water are different at different Places.

The Tides rising higher in Bays and Rivers than in the open Sea, is occasioned by its striking against the contracting Banks of Bays and Rivers, accumulate the Water and cause it to rise higher than in the open Seas.

The Tides are higher than ordinary twice every Year, viz. about the Vernal and Autumnal Equinoxes, and the Neap Tides less, which are occasioned by the Sun's being nearer to the Earth at these Times than at any other Time of the Year, and consequently the Power of Attraction is stronger; for by drawing up the Water when the Sun and Moon are upon the Meridian to a greater Height than ordinary, the Water 90° distant from the Meridian, must subside in the same Proportion.

The Method generally prescribed for finding the Time of High Water at any Place, is contained in the following particulars.

To find the Leap Year.

Divide the given Year by 4, if nothing remains it is Leap Year, but if 1, 2, or 3 remains, they shew that it is so many Years after Bisextile, or Leap Year, as the Remainder is: thus, the Year 1775 divided by 4 gives 443, and the Remainder 3 shews that it is the third after Leap Year.

To find the Golden Number of any Year.

RULE. Add one to the given Year, and divide the Sum by 19, the Remainder will be the Golden Number.

E X A M P L E.

Required the Golden Number of 1775.

By adding one to the present Year, gives 1776, this divided by 19 gives 93 for the quotient, and the Remainder is 9, the Golden Number for 1775.

To find the Epact for any Year.

RULE. Divide the given Year by 19, the Remainder multiply by 11, and the Product will be the Epact, if it does not exceed 29; but if it does, subtract 30 from it as often as you can, and the Remainder will be the Epact, for it never exceeds 29.

E X A M P L E.

What is the Epact of the Year 1775?

1775 divided by 19 gives 93, and the Remainder 8 multiplied by 11 gives 88; this divided by 30 gives 2, and the Remainder is 28; which is the Epact for 1775.

To find the Moon's Age.

To the Epact add the Day of the Month and the Epact, or Number for the Month, the Sum, if it does not exceed 30, is her age; but if it does, subtract 30 from it as often as you can, and the Remainder is her Age.

The Epact, or Numbers for each Month are as follows:

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
com. Yrs.	0	2	0	2	2	4	4	6	7	8	10	10
Leap. Yrs.	0	2	1	3	3	5	5	7	8	9	10	11

E X A M P L E.

Required the Moon's Age the 17th of April 1775.

To the Epact 28 add the Number for the Month 2, and the Day of the Month 17, the Sum is 47, from which take 30, and the Remainder 17 is the Moon's Age for the given Day.

To find the Moon's Southing on any Day of her Age.

Since the Sun returns to the Meridian he has left in the Space of 24 Hours, and the Moon in about 24 Hours 49 Minutes, therefore, if the Moon leaves the Meridian at the same Time that the Sun does on any Day, the next Day she will come to the Meridian 49 Minutes after him, falling back about 49 Minutes every Day, whence to find the Time of the Moon's South, or coming to the Meridian on any Day, we have this easy Rule.

RULE. Multiply the Day of her Age by 49, and divide the Product by 60, the Quotient is the Hours, and the Remainder the Minutes Afternoon when she souths. Or, which is rather easier, and in many respects sufficiently exact for the Mariner's Purpose;

Multiply the Moon's Age by 4, and divide the Product by 5, the Quotient is the Hours, and the Remainder multiplied by 12 gives the Minutes after Noon when she is upon the Meridian.

R

N. B.

N. B. From the Full Moon to the Change she comes to the Meridian, or souths in the Afternoon; but from the Change to the Full, in the Morning.

Required the Moon's Southing September 1, 1775?

The Epact is	28	Moon's Age	6	or thus	6
Number for the Month is	7	Multipled by	49		4
Day of the Month	1				
			6.0)29.4		5)24
	36				
Subtraet	30	Moon's Southing	4 45	Moon's Southing	4 48
Remainder is the M. Age	6				

Hence it appears, that the Moon comes to the South at 54, or 48 Minutes after four in the Afternoon.

To find the Time of High Water on any Time of the Moon's Age at any Place.

From the Observations of many Persons there have been collected the Times when it is High Water on the Days of the New and Full Moon on most of the Sea Coasts of Europe, and at several other Places, and these Times are commonly put in a Table against the Names of the Places in an alphabetical Order, for which Reason it is called the Tide Table; but in this Treatise the Times of High Water, at Full and Change are set down before the Latitude and Longitude of each Place in the Table of Latitudes and Longitudes of Places.

RULE. To the Time of the Moon's southing on the given Day, add the Time of High Water at Full and Change at the given Place, taken from the Table; the Sum is the Hour, past Noon, on the given Day when it is High Water at the given Place.

And if this Hour exceeds 12, subtract 12 Hours 24 Minutes from it, and the Remainder shews the Time of High Water after Midnight; but if it exceeds 24, subtract 24 from it, and the Remainder shews the Time of High Water the next Day, which being reduced back to the given Day, by allowing 12 Hours 24 Minutes for a Tide gives the Time of High Water the given Day.

E X A M P L E I.

At what Time will it be High Water at London, Sept. 1, 1775?

To the Time of the Moon's southing that Day, 4 Hours 54 Minutes, add 3 Hours, the Time answering to London in the Table, and you have 7 Hours 54 Minutes, the Time of High Water at London in the Morning.

E X A M P L E II.

Required the Time of High Water at the Lizard the same Day?

The Moon's southing 4 Hours 54 Minutes, added to the Time of High Water at the Lizard 7 Hours 30 Minutes, gives 12 Hours 24 Minutes after Noon, from which subtract 12 Hours, 24 Minutes, Half a Lunar Day, there Remains nothing, which shews that it is High Water at the Lizard at 12 o'Clock, Sept. 1, 1775.

E X A M P L E III.

Required the Time of High Water at London, the 4th of August 1776.

To the Epact for 1776	9	or thus, the Moon's Age	19
Add the Day of the Month	4		49
And Num. for the Month	6		
			171
The Moon's Age	19		76
	4		
			6.0) 93.1
	5) 76		
	15.1 = 12 M.	Moon's Southing	15. 31
		Time at London	3 —

Hence it appears that it is High Water at London at 18 31 from which subtracting 12 H. 24 M. Half a Lunar Day, there Remains 6 H. 7 M. P. M. the Time of High Water at London.

This is the Method of finding the Time of High Water inferted in common Books of Navigation, which, at Times, will give the Moon's Age whole Days, and the Time of her southing, and of High Water, Hours wide of the Truth; and even if the Moon's southing be exactly found, yet the Tides may differ less or more from the computed Time; for the Floods do not always happen at the same Distance of Time from each other, but at different Distances, according to the Times of the Moon's Age, and her Aspect with respect to the Sun, or as the Waters are acted upon by the Sum or Difference of the attractive Forces of the Sun and Moon, and also on Account of Winds and Storms, even when out of Hearing, which greatly affect the Tides; the real Times of High Water at any Place will often differ from the computed Times; therefore Pilots, and all concerned, would do well to use the following Method, which will in general give the Time of High Water within Half an Hour of the Truth, when the Tides are not greatly influenced by the Winds.

Find the Moon's Age in the following Table, shewing the Times of her mean Changes, by reckoning the Number of Days since her last Change, and only observe that the Day on which you are to find her Age is to be excluded; that is,

you are only to count the Days that are completely elapsed since her Change.

Then find the Times answering to her Age, in the second Right Hand Columns in each Page, and add it to the Time of High Water at any Place, gives the Time of High Water at that Place on the given Day.

E X A M P L E I.

Required the Time of High Water at London, Sept. 1, 1775?

Opposite to 1775, and under August in the Table, I find it is a new Moon the 26th, at five in the Morning, and reckoning forward to September 1, I find she is six Days old. In the Table of Times, and opposite to 6 Day, stands 3 H. 44 M. which add to 3 Hours (the Time making High Water at London at Full and Change) gives 6 H. 44 M. the Time of High Water at London, Sept. 1, 1775.

E X A M P L E II.

At what Time will it be High Water at London the 4th of August, 1776.

In the Table against 1776, and under July, I find it is new Moon the 16th, at one in the Morning, and reckoning forward to August 4th, I find the Moon is 19 Days old; then opposite to 19 in the Table of Times stand 14 H. 30 M. which being added to 3 Hours, the Time of flowing at London gives 17 H. 30 M. which being above 12, I subtract 12 24 from it, and there remains 5 H. 6 M. the Time of High Water at London in the Afternoon.

By comparing the Results obtained by this Method with those obtained by the common Method, there appears a very considerable Difference, wherefore to use the Table in these Computations is by far the exactest.

If a greater Degree of Accuracy be required, proportional Parts may be taken for any undeterminate Hours and Minutes as in the following

E X A M P L E.

Required the Time of the High Water at the Lizard on the 20th of June 1775?

The Moon's Age on June 20, 1775, is 21 Days 21 Hours; the Time for 21 Days 18 Hours is 16 Hours 37 Minutes, and for 22 Days 00 Hours, 16 Hours 51 Minutes; the Difference is 14 Minutes, Half of which added, on Account of the three Hours, to 16 Hours 37 Minutes, makes 16 Hours 44 Minutes, the Time of the Moon's Age 21 Days 21 Hours, and this added to 7 Hours 30 Minutes, the Time of High Water at the Lizard at new Moon, gives 24 Hours 14 Minutes for the Time past Noon on the given Day when it is High Water there; from which subtracting 12 Hours 29 Minutes, the Time answering to a Tide, or to 12 Hours 24 Minutes, Half a Lunar

Lunar Day, at this Time of the Moon's Age, there remains 11 Hours 45 Minutes P.M. the Time of High Water at the Lizard, June 20, 1775.

Among Pilots it is customary to reckon the Time of Flood, or High Water by the Point of the Compass the Moon bears on at that Time, allowing three Quarters of an Hour for each Point. Thus, in Places where it is Flood at Noon on the Days of Full and Change, the Tide is said to flow North and South, or at 12 o'Clock. In Places where the Moon bears 1, 2, 3, 4, or more Points to the East or West of the Meridian, when it is High Water on the same Days the Tide is said to flow on such a Point, so if the Moon bears S. E. at Flood, it is said to flow S. E. and N. W. or 3 Hours before the Meridian, that is 9 o'Clock, if she bears S. W. it flows S. W. and N. E. or at 3 Hours after the Meridian; and in like Manner for other Points of the Moon's bearing.

A TABLE of the Bearings of the Moon at the Time of High Water, with the Time of those Bearings at the following Places.

When the Moon Bears as follows.		H.	
N.	and S.	12	{ Isle of Alderney, Gibraltar, Southampton, Beachy, Sheerness, a Sand called Kentish Knock, a Sand called the Swin, at the Mouth of the Thames.
N. by E.	S. by W.	0 $\frac{3}{4}$	{ or 45 Minutes past 12, Rochester, Flushing, Malden, Nore
N. N. E.	S. S. W.	1 $\frac{1}{2}$	{ or 30 Minutes past 1, Bell Isle, Tinmouth, Gravefend, Holyhead
N. E. by N.	S. W. by S.	2 $\frac{1}{4}$	{ or 15 Minutes past 2, Berwick, Lisbon, St. Andrew's, Conquet
N. E.	S. W.	3	{ Whitby, London, Amsterdam, Bourdeaux, Bay of Biscay
N. E. by E.	S. W. by W.	3 $\frac{3}{4}$	{ Brest, Huntcliff, Isle of Bas at the Maes, Scarborough
E. N. E.	W. S. W.	4 $\frac{1}{2}$	{ In Breefoud, Ushant, Scilly, Cork, C. Clear
E. by N.	W. by S.	5 $\frac{1}{4}$	{ Humber Mouth, at the Spurn, Torbay, Start, Point
E.	W.	6	{ Hull, Wells, Weymouth, Plymouth, Ramehead
E. by S.	W. by N.	6 $\frac{3}{4}$	{ Bristol, Portland Road, Lynn, Foulness, Foy
E. S. E.	W. N. W.	7 $\frac{1}{2}$	{ Lizard, Land's End, Falmouth, Penryn, C. Barfleur
S. E. by E.	N. W. by W.	8 $\frac{1}{4}$	{ Eddystone, Yarmouth, Needles, Fly, Dublin, I. Fly.
S. E.	N. W.	9	{ Isle of Man, Isle of Wight, E. End, Caskets, Caen
S. E. by S.	N. W. by N.	9 $\frac{3}{4}$	{ N. Foreland, Dungeness, Dunnose, Shoreham
S. S. E.	N. N. W.	10 $\frac{1}{2}$	{ The Downs, Deal, Dover, S. Foreland, S. Helen's
S. by E.	N. by W.	11 $\frac{1}{4}$	{ Margate, Harwich, Repe, Pool, Portsmo. Spithead, Calais
S.	N.	12	{ Dunkirk, Embden, R. Elbe, Coast of Flanders, Ostend.

A T A B L E.

Shewing the Times of all the mean Changes of the Moon to the nearest Hour from the Beginning of the Year 1775, till the End of the Year 1799, according to the new Style.

A TABLE OF TIMES, Which added to the Time of High Water at any Place on the Day of New or Full Moon, shew the Time of High Water at that Place on any other Day of her Age.

Year	Jan.	Feb.	March.	April.	May.	June.	Moon's A		Times.	
	D. H.	D. H.	D. H.	D. H.	D. H.	D. H.	D.	H.	H.	M.
1775	1. 11 a		2. 1 m	30. 3 m	29. 3 a	28. 4 m		00	00	00
	31. 0 a		31. 2 a					06	00	08
								12	00	17
1776	20. 9 a	19. 10 a	19. 10 a	18. 11 m	17. 12 a	16. 0 a	1	00	00	26
1777	9. 5 m	7. 6 a	9. 7 m	7. 8 a	7. 9 m	5. 9 a		06	00	45
1778	28. 3 m	26. 4 a	28. 5 m	26. 6 a	26. 6 m	24. 7 a		12	00	54
1779	17. 0 a	16. 1 m	17. 2 a	16. 3 m	15. 3 a	14. 4 m	2	00	01	11
1780	6. 9 a	5. 10 m	5. 11 a	4. 11 m	3. 12 a	2. 0 a		06	01	19
1781	24. 6 a	25. 7 m	24. 8 a	23. 9 m	22. 9 a	21. 10 m		12	01	28
1782	14. 3 m	12. 4 a	14. 5 m	12. 6 a	12. 6 m	10. 7 a	3	00	01	37
1783								06	01	46
								12	02	54
								18	02	03
1784	22. 9 m	20. 10 a	21. 11 m	19. 12 a	19. 0 a	18. 1 m	4	00	02	12
1785	10. 6 a	9. 7 m	10. 8 a	9. 9 m	8. 10 a	7. 10 m		06	02	21
1786	29. 4 a	28. 5 m	29. 5 a	28. 6 m	27. 6 a	26. 7 m		12	02	30
1787	18. 12 a	17. 1 a	12. 2 m	17. 3 a	17. 3 m	15. 4 a	5	00	03	40
1788	8. 9 m	6. 10 a	7. 11 m	5. 12 a	5. 1 a	4. 1 m		06	03	50
1789	26. 7 m	24. 8 a	26. 9 m	24. 10 a	24. 10 m	22. 11 a		12	03	01
1790	15. 4 a	14. 3 m	15. 5 a	14. 6 m	13. 6 a	12. 7 m		18	03	11
1791								06	03	21
								12	03	32
								18	03	44
1792	23. 10 a	22. 11 m	22. 12 a	21. 1 a	21. 1 m	19. 2 a	6	00	03	56
1793	12. 7 m	10. 8 a	12. 9 m	10. 10 a	10. 10 m	8. 11 a		06	04	09
1794								12	04	23
								18	04	37
								06	04	51
1795	1. 4 a		1. 6 a	29. 7 a	29. 7 m	27. 8 a	7	00	05	06
1796	31. 5 m		31. 6 m					12	05	22
1797	20. 1 a	19. 2 m	20. 3 a	19. 4 m	18. 4 m	17. 5 m	8	00	05	40
1798	9. 10 a	8. 11 m	8. 12 a	7. 0 a	7. 1 m	5. 1 a		06	06	00
1799	27. 7 a	26. 8 m	27. 9 a	26. 10 m	25. 10 a	24. 11 m		12	06	20
1799								18	06	39
								06	06	58
								12	07	18
1799								18	07	37
								06	07	56
								12	08	14
1799								18	08	31
								06	08	47
								12	09	02
1799								18	09	17
								06	09	31
								12	09	44
1799								18	09	56
								06	10	09
								12	10	21
1799								18	10	32
								06	10	43
								12	10	53
1799								18	11	03
								06	11	13
								12	11	23

N. B. a signifies Afternoon, and m the Morning, or after Midnight.

Year	July.	August	Sept.	Oct.	Nov.	Dec.	Moon's A.		Times.	
	D. H.	D. H.	D. H.	D. H.	D. H.	D. H.	D.	H.	H.	M.
1775	27. 5 a	26. 6m	24. 6 a	24. 7m	22. 8 a	22. 9m	14	00	11	33
1776	16. 1m	14. 2 a	13. 2m	12. 3 a	11. 4m	10. 5 a		06	11	42
				1. 12 a				12	11	51
1777	5. 10m	3. 11 a	2. 0 a	31. 1 a	30. 2m	29. 3 a	15	00	12	08
								06	12	17
1778	24. 8m	22. 9 a	21. 9m	20. 10 a	19. 11m	18. 12 a		12	12	26
1779	13. 5 a	12. 6m	10. 6 a	10. 7m	8. 8 a	8. 9m	16	00	12	36
								c6	12	45
1780	2. 1m	30. 3m	28. 3 a	28. 4m	26. 5 a	26. 6m		12	13	54
	31. 2 a							18	13	02
1781	20. 11 a	19. 0 a	17. 12 a	17. 1 a	16. 2m	15. 3 a	17	00	13	11
1782	10. 8m	8. 9 a	7. 9m	6. 10 a	5. 11m	4. 12 a		06	13	19
								12	13	28
1783	29. 5m	27. 6 a	26. 6m	25. 7 a	24. 8m	23. 9 a		18	13	37
1784	17. 2 a	16. 3m	14. 3 a	14. 4m	12. 5 a	12. 6m	18	00	13	46
								06	14	54
1785	6. 11 a	5. 0 a	4. 1m	3. 1 a	2. 2m	1. 3 a		12	14	03
						31. 3m		18	14	12
1786	25. 8 a	24. 9m	22. 9 a	22. 10m	20. 11 a	20. 0 a	19	00	14	21
1787	15. 5m	13. 6 a	12. 6m	11. 7 a	10. 8m	9. 9 a		06	14	30
								12	14	40
1788	3. 2 a	2. 3m	30. 4m	29. 5 a	28. 6m	27. 7 a		18	14	50
		31. 4 a						06	15	01
1789	22. 0 a	21. 1m	19. 1 a	19. 2m	17. 3 a	17. 4m	20	00	15	11
1790	11. 8 a	10. 9m	8. 9 a	8. 10m	6. 11 a	6. 0 a		12	15	21
1791	30. 6 a	29. 7m	27. 7 a	27. 8m	25. 9 a	25. 10m	21	00	15	32
1792	19. 3m	17. 4 a	16. 4m	15. 5 a	14. 6m	13. 7 a		06	15	44
1793	8. 0 a	7. 1m	5. 1 a	5. 2m	3. 3 a	3. 4m		12	15	56
1794	27. 9m	25. 10 a	24. 10m	23. 11 a	22. 0 a	22. 1m	22	00	16	09
1795	16. 6 a	15. 7m	13. 7 a	13. 8m	11. 9 a	11. 10m		12	16	23
								18	16	37
1796	5. 2m	3. 3 a	2. 4m	1. 4 a	29. 6 a	29. 7m	23	00	16	51
				31. 5m				06	17	06
1797	23. 12 a	22. 1 a	21. 1m	20. 2 a	19. 3m	18. 4 a		12	17	22
1798	13. 9m	11. 10 a	10. 10m	9. 11 a	8. 0 a	8. 1m		18	17	40
								06	18	00
1799	2. 6 a	1. 7m	29. 8m	28. 9 a	27. 10m	26. 11 a	24	00	18	20
		30. 8 a						12	18	39
								18	18	58
								00	19	18
								06	19	37
								12	19	56
								18	20	14
								00	20	31
								06	20	47
								12	21	02
								18	21	17
								00	21	31
								06	21	44
								12	21	56
								18	22	09
								00	22	21
								06	22	32
								12	22	43
								18	22	53
								00	23	03
								06	23	13
								12	23	23
								18	23	33
								00	23	42
								06	23	51
								12	24	00

In some Places it is High Water on the Shore while the Tide continues to flow in the Stream or Offing. If it runs 3 Hours longer it is called Tide and Half Tide; an Hour and an Half makes Tide and Quarter Tide; three Quarters of an Hour makes Tide and Half Quarter Tide, &c.

In some Places it is High Water on the Shore while the Tide continues to flow in the Stream or Offing. It runs 3 Hours longer it is called Tide and Half Tide; an Hour and an Half makes Tide and Quarter Tide; three Quarters of an Hour makes Tide and Half Quarter Tide, &c.

To rectify or adjust Hadley's Quadrant.

1. *For the Fore Observation.*

BRING the Index close to the Bottom, that the Middle of the Vernier's Scale stand against 0 Degrees: Hold the Plane of the Instrument vertical, with the Arch downwards; look through the Right-hand Hole in the Vane, and direct the Sight through the transparent Part of the Glass to observe the Horizon. Now if the Horizon Line, seen both in the Quick-silvered Part, and through the transparent Part, should coincide, or make one straight Line, then is the Glass truly adjusted: But if one of the Horizon Lines stand above the other, slacken the Screw in the Middle of the Lever, backwards or forwards, as there is Occasion, until the Horizon Lines coincide; fasten the Screw in the Middle of the Lever, and then is the Horizon Glass adjusted.

2. *For the Back Observation.*

Turn the Button on one Side, and set the Middle Line of the Index as many Degrees before 0 Degrees as is twice the Dip of the Horizon; on your Height above the Water (found in the Table following), hold the Plane of the Instrument vertically with the Arch downwards, look through the Hole in the Vane, and if the Horizon Line, seen through the transparent Slit in the Glass, coincides with the Image of the Horizon, seen in the Quick-silvered Part of the same Glass, then is the Glass in its Position: If not, slacken the Screw-pin in the Middle of the Lever behind the Glass, and looking through the Vane as before directed, turn the Screw at the End of the Lever backwards or forwards, as it is wanted, until the Horizon Line coincides; then tighten the Middle Screw, and the Glass is adjusted. In setting this Glass by the opposite Horizon, the Head should be held a little backwards, not to intercept the Light from behind. The Horizon seen from behind will be inverted; that is, the Water will appear above, and the Sky below; and if the two Horizon Lines cross one another, the Instrument is not held upright.

Another Adjustment which ought not to be omitted.

Hold the Plane of the Quadrant parallel to the Horizon, and the Index being brought to the Beginning of the Arch, if the Horizon of the Sea, or Line of the Sea, seen by Refraction in the Quick-silvered Part of the Horizon Glass, be higher than the same seen directly through the transparent Part of that Glass, unscrew the nearest Screw a little, and screw up the opposite one till the direct and refracted Horizons agree; on the contrary, if the refracted Horizon is lower

lower than the true one, unscrew the Screw farthest from you, and screw up the nearest one till the two Horizons agree; and take Care to leave both the Screws tight, by screwing them up equally if they are slack.

To take the Sun's Altitude with Hadley's Quadrant.

1. *By the Fore Observation.*

Fix the Screens above the Horizon Glass, using either or both of them, according to the Strength of the Sun's Rays, by turning one or both of the Frames of these Glasses close against the Plane or Face of the Instrument; then, the Face being turned towards the Sun, hold the Quadrant by the Braces, or by either Radius, as is found most convenient, so as to be in a vertical Position, with the Arch downwards; put the Eye close to the Right Hand Hole in the Vane, look at the Horizon through the transparent Part of the Horizon Glass; at the same time, move the Index with the Left Hand until the Image of the Sun, seen in the quick-silvered Part, falls in with the Line of the Horizon, taking either the Upper or Under Edge of the Solar Image: Swing your Body gently from Side to Side, and if the Edge of the Sun used be observed not to cut, but to touch the Horizon Line, like a Tangent, the Observation is well made: Then shall the Degrees on the Arch, reckoned from that End next your Body, give the Altitude of that Edge of the Sun which was brought to the Horizon. If the Lower Edge was observed, then 16 Minutes added to the said Degrees, gives the Altitude of the Sun's Centre; but if the Upper Edge was used, the 16 Minutes must be subtracted.

2. *By the Back Observation.*

Put the Stem of the Screens into the Hole next the Horizon Glass, using them as before, according to the Strength of the Sun's Rays; then the Back being turned to the Sun, hold the Instrument by the Radius and Brace in a vertical Position, with the Arch downwards; put the Eye close to the Hole in the Vane, look for the Horizon through the transparent Slit in the Glass, with the Right Hand move the Index until the Image of the Sun, seen in the quick-silvered Part of the Glass, stands in the Horizon Line, seen through the transparent Slit, using either the Upper or Under Edge of the Sun; swing your Body gently to the Right and Left, to try if the Sun's Edge runs along the Horizon; if it does, the Observation is well made, and the Degrees reckoned from that End of the Arch farthest from your Body, will give the Altitude of that Part of the Sun which was observed. If the Sun's lower Edge was observed, then 16 Minutes subtracted from the before found Degrees, will give the Altitude of the Sun's Centre; but if the upper Edge was

observed, then the 16 Minutes are to be added. In either of these Observations, if the Altitude of the Centre could be observed, there would then be no need of using the 16 Minutes.

To find the Sun more easily in the Horizon, turn your Back to the Sun, and look through the Vane and Glass down in the Middle of the Shadow of your Head, move the Index forwards until the refracted Image of the Horizon before you is brought down to the Place you look on in the Glass, and the Index will then be set pretty near to the Altitude, and so fitted to find the Sun more readily, either in the fore or back Observation.

The fore Observation is most convenient, especially in great Altitudes, because there is a much larger Scope above and below the Altitude wanted, then there is in the back Observation; which, on Account of the Obliquity of the Speculum and Horizon Glasses, is more contracted in its Use; and indeed the back Observations need never be used for the Sun where there is a clear Horizon forwards, or under the Sun. When this is hazy and ill defined, then it is best to use the back Observation, if the Horizon is clear that Way; and therefore it is proper that the Horizon Glass should be always in Readiness, by having it well adjusted; which, because the former Method is not readily attained by beginners, we shall annex another, which is somewhat more convenient.

Another Way to adjust for the Back Observation.

Take the Altitude of the lower Edge of the Sun, by the fore Observation, as near to Noon as can be, then put the Screens into the Hole near the Sun, and turning your Back to the Sun, and holding the Instrument properly, taking Care not to move the Index, look for the Horizon Line through the transparent Slit of the Glass, and if the Horizon Line touches the upper Edge of the Sun's Image in the Glass, it is properly adjusted: If they do not touch, turn the Glass by the Lever behind it, till they do. This Operation must be done quickly, before the Sun sensibly alters in Altitude, and may be frequently repeated to make the fore and back Observations agree.

To take the Altitude of a Star by Hadley's Quadrant.

Look directly up at the Star through the Vane and transparent Part of the Glass, the Index being close to the Button, then will the Image of the Star, by Refraction, be seen in the silvered Part right against the Star seen through the other Part; move the Index forward, and, as the Image descends, let the Centre of the Quadrant descend also, to keep it in the silvered Part, till it comes down in a Line with the Horizon seen through the transparent Part, and the Observation is made.

By a Back Observation.

Through the Vane and the transparent Slit in the Glass look directly at the Star, at the same Time, move the Index till the Image of the Horizon behind you, being refracted by the great Speculum, is seen in the Quick-silvered Part, and meets the Star, and the Index will then shew the Degrees of Altitude.

Hadley's Quadrants having of late been applied to take the necessary Observations for finding the Longitude at Sea, it has been found, that such Observations require a Degree of Accuracy, which the Instruments constructed in the common Way, were not capable of; to remedy which, several Artists have applied different Articles. Particularly,

A Screw to the lower End of the Index, to regulate its Motion, when brought by the Hand to a Division, nearly shewing the Contact required; and a manifesting Glass to read off the Division between the Limb and the Varnier.

A small Tube or Telescope, instead of the Sight Vanes, to direct the Lines of Sight in a Position parallel to the Plane of the Quadrant, which Tube is screwed into a Ring fixed to a Square Stand that slides into the Socket made for the Sight Vane, and by the help of a Screw in its Bottom, at the Back of the Quadrant, the Stem can be raised or lowered, so as to move the Axis of the Telescope to point to any Part of the Horizon Glass, judged fittest for the Observation.

The extending the Arch from an Octant to a Sextant, or sixth Part of a Circle, whereby the Angular Distance can be taken between two Objects to 120° , which is sometimes wanted in taking the Distance between the Moon and Sun; and the same Directions do for the Sextant that are given for the Quadrant, it being only a larger Portion of a Circle; also for the Convenience of holding the Instrument in such Observations, a stout Handle is fixed to the Back, and is a very necessary Addition.

To make an artificial Horizon.

One great Inconvenience that Mariners have to struggle with at Sea, is the frequent Want of a Horizon; for though the Atmosphere may, at the Height of 10 or 12 Degrees and upwards, be clear enough to give a View of the Sun, or other Objects, yet all below that Height is often so hazy as to hinder a distinct Sight of the Horizon, and consequently an Observation made at such a Time cannot have the Correctness wished for. To remedy this, many Methods have been proposed, the best of which is,

In a Wooden or Iron circular Box, of about $2\frac{1}{2}$ or 3 Inches diameter, and about $\frac{1}{2}$ an Inch deep, pour about a Pound or more of Quicksilver, and on this lay a Metal Speculum, or Piece of plain Glass, whose Diameter is about $\frac{2}{3}$ of an Inch less than that of the

Box; this will float in the Quicksilver, and shew the Image of the Sun very steady. This Apparatus being slung in Jimbals, will preserve a tolerable good Horizon. The Speculum, or Glass, should be homogeneus, and have parallel Sides. There are some Workmen who can work the two Planes of a Piece of Glass, so that they shall be demonstratively parallel; or the fine Surface of the Quicksilver will do itself. In all Observations made with these artificial Horizons, a Piece of coloured Glass should be fixed before the Vane used, to preserve the Eye, and the Screen may be taken off.

The Rays of Light in passing through the Atmosphere are bent out of their straight Course into a curve Line; and hence it happens that all the Heavenly Bodies, except when they are in the Zenith, appear higher than they ought to do, and so much the more the nearer they are to the Horizon. This apparent Elevation of the Heavenly Bodies above their true Height is called the Refraction of their Light, or, in common speaking, the Refraction of the Objects; and the Quantity or Effect of it, according to the different Altitudes of Objects, has been carefully observed by eminent Astronomers, and must always be subtracted from the apparent Altitude, but added to the apparent Zenith Distance of an Object, with whatever Instrument the Observation is made, in order to obtain its true Altitude or Zenith Distance.

That the Corrections of observed Altitudes of Objects, both on Account of the Dip of the Horizon and the Refraction of their Light, may appear at one View, they are both exhibited together in the following Table.

A Table of the Refraction of the Heavenly Bodies, to be subtracted from the observed Altitude.

Elevation of the Eye above Sea in Feet		Dip of the Hor of the Sea		A Table of the Refraction of the Heavenly Bodies, to be subtracted from the observed Altitude.																								
1 11		0 11		App. Alt.		Refrac.		App. Alt.		Refrac.		App. Alt.		Refr		App. Alt.		Refr		App. Alt.		Refr		App. Alt.		Refr		
1 0 57		0 33 0		4 50		10 11		10 30		5 0		26 0		1 56		59 0		0 34		0 34		0 34		0 34		0 34		
2	1 21	5	32 10	5	0	9	54	10	45	4	53	27	1	51	60	33	33	33	33	33	33	33	33	33	33	33	33	33
3	1 39	10	31 22	5	10	9	38	11	0	4	47	28	1	41	61	32	32	32	32	32	32	32	32	32	32	32	32	32
4	1 55	15	30 35	5	20	9	23	11	15	4	40	29	1	42	62	30	30	30	30	30	30	30	30	30	30	30	30	30
5	2 08	20	29 50	5	30	9	8	11	30	4	34	30	0	38	63	29	29	29	29	29	29	29	29	29	29	29	29	29
6	2 20	30	28 22	5	40	8	54	11	45	4	29	31	1	35	64	28	28	28	28	28	28	28	28	28	28	28	28	28
7	2 31	32	28 5	5	50	8	41	12	0	4	23	32	1	31	65	26	26	26	26	26	26	26	26	26	26	26	26	26
8	2 42	36	27 30	6	0	8	28	12	20	4	16	33	1	28	66	25	25	25	25	25	25	25	25	25	25	25	25	25
9	2 52	40	27 0	6	10	8	15	12	40	4	9	34	1	24	67	24	24	24	24	24	24	24	24	24	24	24	24	24
10	3 1	50	25 42	6	20	8	3	13	0	4	3	35	1	21	68	23	23	23	23	23	23	23	23	23	23	23	23	23
12	3 18	1	0 24 29	6	30	7	51	13	20	3	57	36	1	28	69	22	22	22	22	22	22	22	22	22	22	22	22	22
14	3 34	1	10 23 20	6	40	7	40	13	40	3	51	37	1	16	70	21	21	21	21	21	21	21	21	21	21	21	21	21
16	3 49	1	20 22 15	6	50	7	30	14	0	3	45	38	1	13	71	19	19	19	19	19	19	19	19	19	19	19	19	19
18	4 3	1	30 21 15	7	0	7	20	14	20	3	40	39	1	10	72	18	18	18	18	18	18	18	18	18	18	18	18	18
20	4 16	1	40 20 18	7	10	7	11	14	40	3	35	40	1	8	73	17	17	17	17	17	17	17	17	17	17	17	17	17
22	4 28	1	50 19 25	7	20	7	2	15	0	3	30	41	1	5	74	16	16	16	16	16	16	16	16	16	16	16	16	16
24	4 40	2	0 18 35	7	30	6	53	15	30	3	24	42	1	3	75	15	15	15	15	15	15	15	15	15	15	15	15	15
26	4 52	2	10 17 48	7	40	6	45	16	0	3	17	43	1	1	76	14	14	14	14	14	14	14	14	14	14	14	14	14
28	5 3	2	20 17 4	7	50	6	37	16	30	3	10	44	59	77	13	13	13	13	13	13	13	13	13	13	13	13	13	13
30	5 14	2	30 16 24	7	0	6	29	17	0	3	4	45	57	78	12	12	12	12	12	12	12	12	12	12	12	12	12	12
35	5 39	2	40 15 45	8	10	6	22	17	30	2	59	46	55	79	11	11	11	11	11	11	11	11	11	11	11	11	11	11
40	6 2	2	50 15 9	8	20	6	15	18	0	2	54	47	53	80	10	10	10	10	10	10	10	10	10	10	10	10	10	10
45	6 24	3	0 14 36	8	30	6	8	18	30	2	49	48	51	81	9	9	9	9	9	9	9	9	9	9	9	9	9	9
50	6 44	3	10 14 4	8	40	6	1	19	0	2	44	49	49	82	8	8	8	8	8	8	8	8	8	8	8	8	8	8
60	7 23	3	20 13 34	8	50	5	55	19	30	2	39	50	48	83	7	7	7	7	7	7	7	7	7	7	7	7	7	7
70	7 59	3	30 13 6	9	0	5	48	20	0	2	35	51	46	84	6	6	6	6	6	6	6	6	6	6	6	6	6	6
80	8 32	3	40 12 40	9	10	5	42	20	30	2	31	52	44	85	5	5	5	5	5	5	5	5	5	5	5	5	5	5
90	9 3	3	50 12 15	9	20	5	36	21	0	2	27	53	43	86	4	4	4	4	4	4	4	4	4	4	4	4	4	4
100	9 33	4	0 11 51	9	30	5	31	21	30	2	24	54	41	87	3	3	3	3	3	3	3	3	3	3	3	3	3	3
		4	10 11 29	9	40	5	25	22	0	2	20	55	40	88	2	2	2	2	2	2	2	2	2	2	2	2	2	2
			11 8	9	50	5	20	23	0	2	14	56	38	89	1	1	1	1	1	1	1	1	1	1	1	1	1	1
			10 48	10	0	5	15	24	0	2	7	57	37	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			10 29	10	15	5	7	25	0	2	2	58	35															

To work an Observation, or to find the Latitude of a Place by the Tables of the Sun or Star's Declination and the Zenith Distance.

The Latitude of any Place is its Distance from the Equator, either North or South, counted in Degrees, &c. upon an Arch of the Meridian, contained between the Zenith, or that Point directly over your Head, and the Equator. It can never exceed 90 Degrees, and is found by taking the Altitude or Height of the Sun or Star above the Horizon of the Sea with a Quadrant, when on the Meridian or due North or South of the Place of Observation.

This Meridian Altitude, corrected for Dip of the Horizon, and Refraction, and 16 Minutes the Sun's Semidiameter added thereto, gives the Altitude of his Centre, which being subtracted from 90° gives the Zenith Distance, or the Number of Degrees, &c. the Centre of the Object is from the Point over your Head; with which, and knowing how far the Object is to the North or South of the Equator, which is called Declination, the Latitude is found by the Meridian Altitude of any Celestial Object as follows:

1st. If the Sun or Star be South when observed, call the Zenith Distance South; but if North, call it North.

Then if the Zenith Distance and Declination be of contrary Names; that is, if the Sun or Star comes to the Meridian in the North, and hath South Declination; or to the South, and hath North Declination, the Zenith Distance, added to the Declination, gives the Latitude of the Place of Observation; and of the same Name the Declination is of, whether North or South.

2dly. When the Zenith Distance and Declination are of the same Name; that is, when the Sun or Star comes to the Meridian in the North, and hath North Declination; or to the South, and hath South Declination, subtract the Lesser from the Greater, and the Remainder is the Latitude; and to know whether it is North or South observe this general Rule.

When the Declination is greater than the Zenith Distance, the Latitude is of the same Name with the Declination; but if less, of a contrary Name.

NOTE 1st. When the Sun or Star is on the Equator, or hath no Declination, the Zenith Distance is the Latitude of the Place, and of a contrary Name to the Zenith Distance.

2dly. When the Sun or Star is in the Zenith, the Declination is the Latitude, and of the same Name as the Declination is of: For it is evident, that as they are equally distant from the Equator, and on the same Side of it, consequently if the Declination be North, the Latitude will be also North, and if South, South.

EXAMPLE I.

Being at Sea the 27th of May, 1774, the Sun's Meridian Altitude was found to be $57^{\circ} 35'$, and it was South of me; what Latitude was I in?

	$90^{\circ} 00'$	
Meridian Altitude	<u>$57 \quad 35$</u>	
Zenith Distance	$32 \quad 25$ S.	
Sun's Decl. in Table for } May 27 is	<u>$21 \quad 21$ N.</u>	
Lat. in	<u>$53 \quad 46$ N.</u>	

EXAMPLE II.

Being at Sea the 24th of July, 1775, the Meridian Altitude of the Sun was $27^{\circ} 13'$, being North of me; required the Latitude in?

	$90^{\circ} 00'$	
Mer. Alt.	<u>$27 \quad 13$ N.</u>	
Zenith Dist.	$62 \quad 47$ N.	
Sun's Decl. in Table for } July 24th.	<u>$19 \quad 55$ N.</u>	
Lat. in	<u>$42 \quad 52$ S.</u>	

EXAMPLE III.

Being at Sea 14th of January, 1775, the Sun's Meridian Altitude was found $72^{\circ} 17'$ N. What was the Latitude of the Place of Observation?

	$90^{\circ} 00'$	
Mer. Alt.	<u>$72 \quad 17$ N.</u>	
Zen. Dist.	$18 \quad 43$ N.	
Declination	<u>$23 \quad 17$ S.</u>	
The Lat. in	<u>$4 \quad 34$ N.</u>	

In this Case it is plain that the Observer was between the Sun and the Equator.

EXAMPLE IV.

Being at Sea the 4th of May, 1774, I observed the bright Star Fomelhaut $27^{\circ} 21'$ above the Horizon of the Sea, and it was North of me; required the Latitude in?

	$90^{\circ} 00'$	
Mer. Alt.	<u>$27 \quad 21$</u>	
Zen. Dist.	$52 \quad 39$ N.	
Fomelhaut's Deal P. Tab.	<u>$30 \quad 50$ S.</u>	
The Lat. in	<u>$21 \quad 49$ S.</u>	

The foregoing Rules are for observing by the Sun or Stars when they are at their greatest Altitude, or upon the Meridian above the Pole; but as in some Parts of the Earth the Sun does not set for several Days, and some Stars never set, in that Case they may be observed upon the Meridian twice in the twenty-four Hours, that is, once at their greatest height as before, and again when they are at the lowest; or upon the Meridian below the Pole, to work which Observations take the following Rule.

RULE. Add the Complement of the Declination to the Meridian Altitude, the Sum is the Latitude of the same Name with the Declination.

EXAMPLE V.

At Sea I took the Altitude of the North Pole Star, when on the Meridian below the Pole, and found it $46^{\circ} 21'$ required the Latitude?

The

The Meridian Altitude	46°	21' N.
Com. Declination	—	1 55
The Lat. in	—	48 16 N.

In the following Examples the Corrections for Dip Refraction are introduced.

EXAMPLE VI.

By a fore Observation the Altitude of the Sun's lower Edge was found by Hadley's Quadrant to be 40° 20' S. when his Declination was 9° 56' N. the Eye being 30 Feet above the Horizon.

Required the Latitude of the Place.
Obs. Alt. Sun's lower Edge 40° 20' S.
Semidiam. to be added 0 16

App. Alt. Sun's Center 40 36
Dip. of Hor. to be Subtr. 0 05

App. Alt. Cor. by the Dip 40 31
Refract. to be Subtr. 0 01

True Alt. of Sun's Center 40 30

True Zenith Distance 49 30 S.

Declination 9 56 N.

Latitude 59 26 N.

EXAMPLE VII.

By a back Observation with Hadley's Quadrant, the apparent Altitude of the Sun's lower Edge was 25° 12' S. when his Declination was 21° 14' S. and the Eye 40 Feet above the Horizon. In what Latitude was the Observation made?

Obs. Alt. Sun's lower Edge 25° 12' S.
Semidiam. to be Subtr. 0 16

App. Alt. Sun's Center 24 56
Dip of Hor. to be added 0 06

App. Alt. Cor. by the Dip 25 02
Refract. to be Subtr. 0 02

True Alt. of Sun's Center 25 00

True Zenith Distance 65 00 S.

Declination 21 14 S.

Latitude 43 46 N.

EXAMPLE VIII.

Suppose the Eye of an Observer at 35 Feet above the Water should with Hadley's Quadrant, by a fore Observation, find the Altitude of Sirius 53° 35' S. when it passed the Meridian, having before Hand set his Watch, and found the Time of Sirius's Passage; required the Latitude of the Place of Observation? Obs. Alt. of Sirius 53° 35' 00" N.
Dip. of Hor. to be sub. 0 05 39

Ap. Alt. above Hor. 53 29 21
Refract. to be sub. 0 00 42

True Alt. of Sirius 53 28 39

True Zen. Dist. 36 31 21 S.

Sirius Declinat. 16 24 42 S.

Latitude 20 06 39 N.

EXAMPLE IX.

Suppose on the 12th of June, 1776, an Observer in an high Northern Latitude, and 65° to the West of London, his Eye being 28 Feet high, observed the Altitude of the Sun's lower Limb on the Meridian below the Pole, to be 8° 15' North by a fore Observation with a Hadley's Quadrant; required the Latitude?

The Sun being observed below the Pole, it must have been at 12 Hours past Noon, at the Place of Observation, and that Place being 65° West of London = 4 Hours 20 Minutes later than at London, there-

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therefore it must have been 16 Hours 20 Minutes past Noon at London.

June 12th, 1776, the Sun's Declination $23^{\circ} 13'$ North, the Daily Variation is 3 Minutes, and 24 H. $3' : : 16h. 20m. : 2' 10''$, which added to $23^{\circ} 13'$ (because the Declination is increasing) gives $23^{\circ} 15' 10''$, the Sun's Declination at the Time of Observation.

App. Alt. Sun's lower Limb $8^{\circ} 15' N$
Semi-diam. added 16

App. Alt. Sun's Centre 8 31
Dip of Hor. sub. 5

Sun's Alt. Cor. by Dip 8 26
Refrac. sub. 6

True Alt. Sun's Centre 8 20
Comp. Sun's Decl. 66 45

Lat. in 75 5 N.

Having in the foregoing Examples exhibited the Method of finding the Latitude by the Meridian Altitude of the Sun or Star, yet, as it often happens, that in coming in with the Land at Night, the Mariner would gladly find his Latitude without waiting for the Star's being upon the Meridian; for which Purpose I shall shew how to find the Latitude by the Table of the Pole Star at any Hour of the Night.

RULE. Having taken the Altitude of the Star, and noted the Time of Observation by your Watch (kept as true as may be), correct it by the Refraction and Dip of the Horizon. This done, the next Thing is to find the Time of the Star's being on the Meridian above the Pole.

If the Time of Observation be not more than 6 Hours distant from the Time just found (of the Star being on the Meridian above the Pole), the Distance of Time will, in the Table, give the Degrees and Minutes to be subtracted from the true Altitude of the Star for the Altitude of the Pole, or Latitude of the Place. But if the Time of Observation be more than 6 Hours distant from the Meridian, it may be observed that, about 12 Hours before the Star is on the Meridian above the Pole, it was, and will be again, about 12 Hours after, on the Meridian below the Pole. Then enter the Table with the Distance of the Time of Observation from the Time of the Star's transiting the Meridian below the Pole, and you will see the Degrees and Minutes to be added to the Latitude required.

N. B. The nearer the Star is to being on the Meridian, the more accurate will the Latitude be found.

A TABLE for the North Star.		
Time the Star is distant from the Meridian.		Star above or below the Pole.
H.	M.	
0	00	$1^{\circ} 56'$
0	15	1 56
0	30	1 55
0	45	1 54
1	00	1 52
1	15	1 50
1	30	1 47
1	45	1 44
2	00	1 40
2	15	1 36
2	30	1 32
2	45	1 27
3	00	1 22
3	15	1 17
3	30	1 11
3	45	1 5
4	00	0 58
4	15	0 51
4	30	0 44
4	45	0 37
5	00	0 30
5	15	0 22
5	30	0 15
5	45	0 7
6	00	0 0

E P A M P L E.

Suppose the Altitude of the North Star was taken at Sea the 3d of December, at 8 at Night, and found (Refraction and Dip of the Horizon being allowed) to be 52 Degrees 10 Minutes; what Latitude was the Ship in?

	H.	M.
The Right Ascension of the Star	0	46
Add	24	0
Sun's Right Ascension subtract	24	46
	16	39
The Star is on the Merid. above the Pole at	8	7 in the Even.
Time of Observation	8	0
Time distant from the Meridian	0	7
Hence from the Altitude of the Star	52°	10' N.
Subtract as by the Table	1	56
Remains the Latitude required	50	14 N.

But if the Time of Observation had been 4 o'Clock in the Morning, that Time is more than 6 Hours distant from the Time of transiting the Meridian above the Pole; therefore we must consider, that, as it was on the Meridian above the Pole at 8 Hours 7 Minutes at Night, it must have been on the Meridian below the Pole about 8 Hours 7 Minutes in the Morning; and therefore subtracting the Time of Observation 4 Hours, the Distance of Time from the Meridian below the Pole is 4 Hours 7 Minutes, which, in the Table, gives 0 Degrees 55 Minutes; which, added to 52 Degrees 10 Minutes, gives the Latitude 53 Degrees 5 Minutes North.

Of the Variation of the Compass.

THE Variation of the Compass is an Arch of the Horizon contained between the Meridian of the Place and the Magnetic Meridian, and is either East or West; or it is the Number of Degrees, &c. The Needle's Point stands from the true North or South Points of the Horizon, reckoned to the Eastward or Westward, and is readily found either from the Sun's Amplitude or Azimuth.

To find the AMPLITUDE.

The Sun's true Amplitude is an Arch of the Horizon comprehended between the true East or West Points thereof, and the Centre of the Sun at his Rising or Setting; or it is the Number of Degrees, &c. The Sun rises or sets to the Northward or Southward of the East or West Points of the Horizon.

The Sun's magnetic Amplitude is the Number of Degrees, &c. his Centre is Northward or Southward of the East or West Points of the Compass at his Rising or Setting, and is found by observing the Sun at his Rising or Setting with an Azimuth Compass.

To find the Variation of the Compass by an Amplitude, you must have the Latitude of the Place, the Declination of the Object, and the magnetic Amplitude given.

The true Amplitude is found either by Inspection in the Tables of the Sun's Amplitude, or by Calculation as follows:

As the Sine Complement of the Latitude
Is to Radius,
So is the Sine of the Sun or Star's Declination
To the Sine of the true Amplitude;

Which is always of the same Name with the Declination, whether North or South; or

To the Arithmetical Complement of the Sine Complement of the Latitude add the Sine of the Sun's Declination, and that Sum will be the Log. of the Sine of the true Amplitude.

NOTE. The Arithmetical Complement of the Co-Sine of any Arch is always equal to the Secant of that Arch, throwing away Radius, or neglecting one, which stands the first Figure in the Secant's Index; likewise the Arithmetical Complement of the Sine of any Arch, is the Co-Secant of that Arch less Radius, or the first Figure of its Index: Wherefore, the Arithmetical Complement of the Sine or Co-Sine of any Arch is found in the Table of Secants by Inspection,

E X A M P L E I.

On the 20th of October, 1777, in Latitude $51^{\circ} 32' N.$ I demand the true Amplitude?

As Sine Com. Lat. $51^{\circ} 32'$	9.79383	Or to Ar. Com. Sine Co. } Lat. $51^{\circ} 32'$	0.20617
Is to Radius	10.00000	Add Sine Sun's Declina- } tion $10.32 S.$	9.26199
So is Si. Sun's Dec. $10^{\circ} 32' S.$	9.26199		
To Si. of true Amp. $17^{\circ} 5'$	9.46816	Sine of the true Amp. } $17.5 S.$	9.46818
		Which is South because the Declination is South.	

E X A M P L E II.

In Latitude $38^{\circ} 25' N.$ what is the Sun's true Amplitude when the Declination is $18^{\circ} 59' N.$

As Sine Com. Lat. $38^{\circ} 25'$	9.89405	Or to Ar. Comp. Sine } Co. Lat. $38^{\circ} 25' N.$	0.10595
Is to Radius	10.00000	Add Sine Declin. $18^{\circ} 59'$	9.51227
So is Sun's Decl. 18.59	9.51227		
To Sun's true Amp. $24^{\circ} 32'$	9.61822	Gives Sine true Ampl. } $24^{\circ} 32'$	9.61822
		Which is North, because his Declination is North.	

To find the true AZIMUTH.

The true Azimuth is an Arch of the Horizon, contained between the Meridian of the Place and the Azimuth Circle passing through the Center of the Sun or Star at the Time of Observation, or it is the true Distance of the Sun or Star, from the true North and South Points of the Compass.

The Magnetic Azimuth is an Arch of the Horizon contained between the Magnetic Meridian, and the Azimuth Circle, passing through the Center of the Sun or Star when observed; or it is the apparent Distance of the Sun or Star, from the North or South Points of the Compass, either in the Forenoon or in the Afternoon when they are 5° , 10° , 15° , &c. above the Horizon, and the less the Altitude is, the more exact you may perform the Observation.

Having the Latitude of the Place of Observation, and the Sun or Star's Declination, with the Altitude at the Time of Observation, the true Azimuth is found as follows.

Add

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Add the Complement of the Latitude, the Complement of the Altitude, and the Sun or Star's Polar Distance into one Sum : from Half that Sum subtract the Polar Distance, and note the Half Sum and the Remainder, but if the Half Sum be less than the Polar Distance, then subtract it from the Polar Distance, and the Difference call the Remainder. Then add together,

The Arithmetical Comp. of the Co-sine of the Latitude,
 The Arithmetical Comp. of the Co-sine of the Altitude,
 The Sine of the Half Sum,
 And the Sine of the Remainder into one Sum.

Half the Sum of these four Logarithms will give the Co-sine of Half the true Azimuth, which being doubled, gives the true Azimuth, reckoned from the North in North Lat. and from the South in South Latitude.

N. B. The Polar Distance of the Sun or Star, is their Distance from the nearest, or elevated Pole, and if the Latitude of the Place, and the Declination of the Sun or Star, be both North or both South, then the Complement of the Declination is the Polar Distance; but if the Latitude and Declination be one North, and the other South, the Declination added to 90° gives the Polar Distance.

E X A M P L E I.

In Latitude $43^\circ 39'$ N. the Sun's Altitude is observed to be $39^\circ 28'$ his Declination being then $16^\circ 37'$ North, required his Azimuth?

Comp. Lat.	46	21	Arithm. Comp. Co-sine Lat.	$43^\circ 39'$	0.14052
Comp. Alt.	50	32	Arithm. Comp. Co-sine Altitude	$39^\circ 28'$	0.11239
Polar Dist.	73	23	Sine Half Sum	85 08	9.99843
			Sine Remainder	11 45	9.30887
Sum	170	0 16'	Sum of the fourth Logarithms		19 56021
Half Sum	85	8	Half the Sum Co-sine	$52^\circ 56'$	9.78010
Sub. Po. Dist.	73	23	And $52^\circ 56'$ doubled gives $105^\circ 52'$ for the		
Remainder	11	45	Sun's true Azimuth to be reckoned from the North.		

E X A M P L E II.

In Latitude $42^\circ 16'$ N. the Sun's Altitude is observed to be $39^\circ 28'$, his Declination being then $16^\circ 37'$ N. required his Azimuth?

Comp.

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Comp. Lat.	47° 44'	Arith. Comp. of the Co-sine Lat.	42° 16'	0.13075
Comp. Alt.	71 20	Arith. Comp. of the Co-sine Alt.	18 40	0.02347
Polar Dist.	97 38	Sine of the Half Sum	108 21	9.97734
		Sine of the Remainder	10 43	9.26940
Sum	216 42	Sum of the four Logarithms		19.40096
Half Sum	108 21			
Sub. Po. Dist.	97 38	Half the Sum is equal to Cosine	59° 53'	9.70048
Remainder	10 43	And 59° 53' doubled gives	119° 46'	for the Sun's true Azimuth to be reckoned from the North.

Having found the Sun's true Amplitude, or Azimuth, by the preceding Methods, &c. Magnetic Amplitude or Azimuth by Observation, it is evident, that when they agree there is no Variation, but when they disagree, then, if the true and observed Amplitudes be both of the same Name; that is, both North or both South, their Difference is the Variation, but if the true and observed Amplitudes be of different Names; that is, one North and the other South, their Sum is the Variation; again, if the true and observed Azimuths be both on the East, or both on the West Side of the Meridian, their Difference is the Variation; but, if the true and observed Azimuth be one on the East, and one on the West Side of the Meridian, their Sum gives the Variation; and to know whether the Variation is Easterly or Westerly, observe this general Rule, viz.

Let the Observer's Face be turned to the Sun, then, if the true Amplitude or Azimuth be to the Right Hand of the Magnetic, or observed, the Variation is Easterly, but if the left Hand, Westerly.

EXAMPLE I.

Suppose the Sun's true Amplitude at Rising is found to be E. 14° 20' N. but by the Compass it is found to be E. 26° 12' N. required the Variation?

From the greater	E. 26° 12' N.
Take the lesser	E. 14 20 N.

Remains the Variation	11 52 E.
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Which is Easterly, because in this Case the true Amplitude is to the right of the observed.

EXAMPLE II.

Suppose the Sun's true Amplitude at Setting be W. 34° 26' S. and his Magnetic Amplitude W. 23° 13' S. required the Variation? since they are both of the same Name?

From the greater	W. 34° 26' S.
Take the lesser	W. 23 13 S.

Remains the Variation	11 13 W.
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which is Westerly, because the true amplitude is to the left of the observed in this Case.

EXAMPLE

EXAMPLE III.

Suppose the Sun's true Amplitude at Rising is E. $13^{\circ} 24'$ N. and his Magnetic Amplitude E. $12^{\circ} 32'$ S. required the Variation and which Way?

Since the true Amplitude and observed have different Names.

To the true Amplitude E. $13^{\circ} 24'$ N.
Add the Magnetic Amp. E. $12^{\circ} 32'$ S.

The Sum is the Variation $25^{\circ} 56'$ W.

which is Westerly, because the true Amplitude is to the left of the observed.

EXAMPLE V.

Suppose the Sun's true Azimuth is N. $32^{\circ} 28'$ Easterly, and his Magnetic Azimuth N. $8^{\circ} 50'$ West. required the Variation, and which Way?

Since they are on the different Sides of the Meridian.

To the true Azimuth N. $32^{\circ} 28'$ E.
Add the Mag. Azm. N. $8^{\circ} 50'$ W.

Sum is the Variation $41^{\circ} 18'$ E.

Which is Easterly, because the true Azimuth is to the Right of the observed.

EXAMPLE IV.

Suppose the Sun's true Azimuth in the Forenoon is N. $86^{\circ} 40'$ Easterly, but by the Compass it is N. $73^{\circ} 24'$ Easterly, required the Variation, and which Way?

Since the true and observed Azimuths are both on the same Side of the Meridian.

From the greater N. $86^{\circ} 40'$ E.
Take the lesser N. $73^{\circ} 24'$ E.

Remainder Variation $13^{\circ} 16'$ E.

Which is Easterly because the true Azimuth is to the Right of the observed.

EXAMPLE VI.

Suppose the Sun's true Azimuth S. $17^{\circ} 45'$ E. and the Magnetic Azimuth S. $5^{\circ} 48'$ West, required the Variation, and which Way?

Since they are on different Sides of the Meridian.

To the true Azimuth S. $17^{\circ} 45'$ E.
Add the observed Az. S. $5^{\circ} 48'$ W.

Sum is the Variation $23^{\circ} 33'$ E.

Which is East, because the true Azimuth is to the Right of the observed.

The Use of the Variation is to correct the Course steered by the Compass; when the Variation is East it must be allowed to the Right Hand upon every Course steered quite round the Compass; but when the Variation is West, to the Left Hand.

NOTE. The Variation may be easily found by taking the Sun's Altitude in the Morning, and observing what Point of the Compass he bears upon; and in the Afternoon when the Altitude is the same, the middle Point will be the true Meridian, the Difference between which and the North or South Points of the Compass is the Variation. If the Altitudes are taken at 5, 6, or 7 o'Clock in the Morning, you will have the same Altitude at 5, 6, or 7 o'Clock in the Evening, being equally distant from Noon.

The Variation of the Compass was first observed at London, in the Year 1580, to be $11^{\circ} 15'$ Easterly; and in the Year 1622, it was

was $6^{\circ} 0'$ E. still decreasing, and the Needle approaching the true Meridian, until it coincided with it in the Year 1662, since that Time the Variation still continues at London to increase Westerly, at the Rate of about 11 or 12 Minutes every Year; and is, at this Time, about $22^{\circ} 30'$ Westerly, and in the English Channel about $23^{\circ} 40'$ Westerly; but how far it will go that Way Time and Observations will probably be the only Means to discover.

The Variation at Paris in the Year 1640, was 3° E. but in the Year 1681 it was $2^{\circ} 31'$ W. and is now about $21^{\circ} 20'$ Westerly, still continuing to go Westerly.

In short, from Observations made in different Parts of the World, it appears, that in different Places the Variation differs, both as to its Quantity and Denomination, it being East in one Place and West in another; the true Cause and Theory of which has not yet been discovered, and therefore in long Voyages it is absolutely necessary that the Mariner should find the Variation of the Compass by Observation as often as possible.

To make an Observation with the Azimuth Compass for an Amplitude.

Move the Box about till the four Cardinal Points coincide with four Lines in the Compass Box, keep the Box steady, and turn the Index till the Center of the Sun, or a Star, at the Rising or Setting, when its lower Edge just touches the Horizon, is seen through both the Sights, then the Degrees intercepted between the North Point of the Compass and that End of the Index pointing to the Sun or Star, will be the Magnetic Amplitude.

FOR AN AZIMUTH.

Set the Box so that the four Cardinal Points of the Card stand opposite to the four Lines in the Compass Box, hold the Box in this Position, and move the Index, till the Sights being directed to the Sun or Star's Center, the Shadow of the String joining the Sights fall directly along the Middle of the Index; then the Degree, &c. in the Arch intercepted between the End of the Index, next the Sun, and North Point of the Card, will give the Magnetic Azimuth required. If the Sun does not shine strong enough to give a strong Shadow, look through one of the Sights, and move the Index till one of the Strings cuts the Sun's Center, and then the intercepted Arch, as before, shews the Sun's Azimuth, and the like of the Star's.

When there is a rough Sea, the Observation is best made by two Persons, and if the Card vibrates much, take the middle Degree between the Limits which the Vibration reaches.

When the Azimuth is observed, the Altitude of the Object must be observed at the same Time.

This Instrument is useful in setting the Ship's Wake in Order to find the Leeway, and also to find the Bearing of the Headlands, and other Objects.

Of the Log-Line and Half-Minute Glaſs, and how to correct the Diſtance given by them.

THE Log is a flat Piece of Wood like a Flounder, or of the Figure of a Sector of a Circle, having its circular Side loaded with Lead ſufficient to make it ſwim upright in the Water. To this Log is faſtened a long Line of about 150 Fathoms, called the Log-Line, which is divided into certain equal Spaces, called Knots, each of which ought to bear the ſame Proportion to a Nautical Mile (60 of which make a Degree) that Half a Minute does to an Hour, that being the Time allowed for the Experiment. They are called Knots, becauſe at the End of each of them there is a Piece of Twine with Knots in it, reeved between the Strands of the Line; theſe Pieces of Twine ſhew how many Knots run out in Half a Minute, and conſequently the Ship's Rate of Sailing per Hour.

Mr. Norwood, and ſeveral other able Mathematicians, have found that a Degree of a great Circle upon the Earth contains about 367200 Engliſh Feet, therefore a Nautical Mile being the $\frac{1}{60}$ Part of 367200 Feet, that is, 6120 Feet, and ſince Half a Minute is $\frac{1}{120}$ Part of an Hour, the Length of a Knot on the Log-Line ought to be the $\frac{1}{120}$ Part of 6120 Feet, or 51 Feet. But as for the moſt Part the Ship's Way is found by Experience to be really more than that given by the Log, and as it is ſafer to have the reckoning before the Ship than after it, therefore 50 Feet may be taken as the proper Length of each Knot, and theſe Knots ſubdivided into ten Fathoms each of 5 Feet, which will correſpond with all the Tables and Inſtruments uſed in Navigation, as they are decimally divided, and conſequently the Ship's Run determined with greater Eaſe and Certainty.

The length of the Log-Line formerly uſed was divided into Knots of 42 Feet, which Way of dividing the Line was founded on the Suppoſition, that 60 Miles, of about 5000 Engliſh Feet, made a Degree; whereas it is abundantly certain, that a Degree contains about 73 ſuch Miles. It were therefore to be wiſhed, that no Line ſo divided were in Uſe, but very often Cuſtom prevails over Reaſon; and although Mariners find by Experience this Length of the Knots to be too ſhort, yet ſome of them rather than quit the old Way, uſe Glaſſes for Half Minute ones that run but 24 or 25 Seconds, which is but correcting one miſtake by another.

The Knots commonly begin to be counted at the Diſtance of 10, 12, or 15 Fathoms from the Log, according to the Largeneſs of the
U Ship,

Ship, that so the Log may be out of the Ship's Wake when it is thrown over board before they begin to count, lest the Eddies should suck the Log after the Ship, and for the more ready Discovery of this Point of Commencement, there is commonly fastened at it a Piece of red Rag; that Part of the Line between the red Rag and the Log is called the Stray Line.

The Log and Log-Line being duly prepared and hove over-board from the Poop, or Lee Quarter, and the Line veered out (by the Help of a Reel which turns easy, and about which it is wound) as fast as the Log will carry it away, or rather as fast as the Ship sails from it, will shew how fast the Ship has sailed in the given Time, or Rate of Sailing per Hour.

The Experiment for finding the Velocity of the Ship, is called heaving the Log. See page 63.

Care should be taken to veer out the Line as fast as the Log takes it, for if the Log is left to turn the Reel of itself, the Log will come home, and deceive you in the reckoning.

In King's Ships, India Ships, and some others, the Log is hove every Hour, but in Coasters, and those using short Voyages, every two Hours.

Here the Ship is supposed to move with equal Velocity between the Times of trying the Experiment. But if the Gale has not been the same during the whole Hour, or Time between heaving the Log, or if there have been more sail set, or any handed, that so the Ship has run more or less in any Part of the Hour than she did at the Time of the Experiment, or if it should fall little or more Wind at that Time, there must be Allowance made for it according to the Discretion of the Artist: sometimes too when the Ship is before the Wind, and a great Sea setting after her, it will bring Home the Log; in such Cases it is customary to allow one Mile in ten, and less in Proportion if the Sea be not so great.

Care should also be taken to measure the Log-Line pretty often, lest it stretch and deceive you in the Distance.

The like Regard must be had, that the Half-Minute Glass be just 30 Seconds, otherwise no Account of the Ship's Way can be kept; to prove which, if there be no Stop at Hand, let a Plummet of any Form, or Weight, be fastened to a Silk String or Thread, with a Loop to hang on a small Pin or Nail fastened in any Place, so that the Plummet may swing freely; let it be $39\frac{1}{2}$ Inches from the End of the Loop to the middle of the Plummet, and the Plummet caused to swing, each of those Swings will be a true Second of Time, always counting every Time it passes the Perpendicular let fall from the Pin, and every Time it passes from the Perpendicular to the utmost Swing will be a Half-Second.

How to correct the Distances given by the Log Line and Half-Minute Glafs.

The Distance given by the Log may be wrong on three Accounts, viz. by an Error in the Glafs, an Error in the Log-Line, or an Error in both ; for correcting of which take the following Rules.

C A S E I.

When the Log-Line is truly divided, and the Glafs is faulty.

RULE. Say, as the Seconds run by the Glafs are to 30 Seconds, so is the Distance given by the Log to the true Distance.

E X A M P L E I.

Suppose a Ship runs at the Rate of $7\frac{1}{2}$ Knots in the Time the Glafs runs out, but measuring the Glafs I find it runs 34 Seconds, what is the true Rate of sailing.

As $34 : 30 :: 7.5 : 6.6$ Miles, the true Distance failed in an Hour.

E X A M P L E II.

Suppose a Ship runs at the Rate of $6\frac{1}{2}$ Knots, but measuring the Glafs I find it runs only 25 Seconds, required the true Rate of Sailing ?

As $25 : 30 :: 6.5 : 7.8$ Miles the true Distance failed in an Hour.

C A S E II.

When the Glafs is true and Log-Line faulty.

RULE. Say as 50 Feet is to the Distance measured between Knot and Knot, so is the Distance run by the Log to the true Distance.

E X A M P L E I.

Suppose a Ship runs at the Rate of $6\frac{1}{4}$ in Half a Minute, but measuring the Space between Knot and Knot, I find it to be 56 Feet, required the true Rate of Sailing ?

As $50 : 56 :: 6.25 : 7$ Miles, the true Distance failed in an Hour.

E X A M P L E II.

Suppose a Ship runs at the Rate of $6\frac{1}{2}$ Knots in Half a Minute, but measuring the Space between Knot and Knot, I find it to be only 44 Feet, required the true Rate of sailing ?

As $50 : 44 :: 6.5 : 5.72$ Miles, the true Distance failed in an Hour.

C A S E . III.

When both the Log-Line and Glafs are faulty.

RULE. Multiply thrice the measured length of a Knot by the Distance run by the Log, the Product divided by 5 Times the measured Time of the Glafs, will give the true Distance run.

E X A M P L E.

Suppose a Ship runs 5 Knots of a Log-Line of 45 Feet to a Knot, while a Glafs of 25 Seconds is running out, what is the true Rate of Sailing.

The measured Length of a Knot	—	45
Multiplied by	—	3
Gives thrice the measured Length of a Knot		135
Which multiply by the Distance run per Log		5
		675

And dividing the Product by 5 Times the Time the Glafs runs, that is $5 \times 25 = 125$, the Quotient is 5.4, the Number of Miles the Ship runs per Hour.

This Rule is only a Compound of the two former simple ones, which is contracted a little.

When the Glafs is faulty, the Log-Line may be divided as in the annexed Table, shewing the Length of the Knots of the Log-Line to different Glaffes.

Seconds of Glafs	Length of Knots in Feet.	
24	40	0
25	41	8
26	43	4
27	45	0
28	46	8
29	48	4
30	50	0
31	51	8
32	53	4
33	55	0
34	56	8
35	58	4
36	60	0

The Method of Keeping a JOURNAL at Sea.

BY keeping a Journal, is meant keeping such an Account of the Ship's Way, that the Mariner may be able at any Time to ascertain the Latitude and Longitude the Ship is in; it therefore should be the great Concern of every Person who takes upon him the navigating of Ships to remote Parts, to be expert therein, as the Lives and Fortunes of so many Men are committed to his Charge.

When a Ship is bound from one Place to another, which lies so far from her, that she is obliged to go out of Sight of Land for any considerable Time, as from England to Jamaica; at the Time of her leaving Sight of Land, she is said to take her Departure, and that Part of the Land she then leaves is said to be the Place she takes her Departure from, such as the Land's End, Lizard, &c. and at the Time of taking such Departure, the Captain or Mate generally takes the Bearing and Distance of that Land (according to his Judgment) and sets it down on the Logboard, or in the Log-book against the Time it was taken, thus Land's End N. N. E. Dist. 7 Leagues, or Lizard N. by W. Dist. 5 Leagues, &c.

In the same Manner may the Departure from any Place be taken, as may be seen in the first Day's Log of the following Journal, where the Log-book is marked in Columns for Hours, Knots, Fathoms, Courses, Winds, Leeway, Transactions; and under it the Columns for Courses, Distances, Northings or Southings, Eastings or Westings, the Latitude by Dead Reckoning, Latitude by Observation, Meridian Distance, Difference of Longitude, Longitude in, and in the last Bearing and Distance of the Land.

Notice must be taken, that in the Column for Course, you are always to set down the Course you have made by your Reckoning for that 24 Hours; that is, from the Noon of the Day before to the Noon of the Day you work on, the Sea Account being always kept from Noon to Noon.

In the Columns for Distance, you are to set down the Distance made by your Reckoning for that 24 Hours.

In the Columns of Northing and Southing you are to set down the Difference of Latitude made in that 24 Hours, marking the Column with North if the Difference of Latitude be North, and South if South.

In the Column of Easting or Westing, you are to set down the Departure made that 24 Hours, marking the Column with East, if the Departure be East, and with West if Westerly.

In the Column marked Latitude by D. R. you are to set down the Latitude you reckon yourself in on that Day, and in the Column marked Lat. by Ob. you are to set down the Lat. found by Observation

vation, also the Difference of Longitude made in the 24 Hours in the Column marked Diff. Long. the Longitude in, in the Column marked Long. in; and in the last, the Bearing and Distance from the Land.

The Variation, if any, must be allowed upon all Courses steered, and upon all Bearings that are taken by the Compass; that is, if it be Easterly Variation, it must be allowed to the Right Hand, if Westerly, to the Left of the Course or Bearing. Supposing yourself placed in the Centre of the Compass, and looking directly forward to the Point you are to allow the Variation upon.

E X A M P L E.

Suppose I steer S. W. and there is one Point Westerly Variation, then my true Course is S. W. by S. or suppose I set a Point of Land, and find it to bear by the Compass E. S. E. and I know there is half a Point Easterly Variation, then the true Bearing is S. E. by E. $\frac{1}{2}$ E.

Lee-way must be allowed upon all Courses steered, which is the Difference between the Point which the Ship endeavours to sail upon, and the Point she really sails upon, and is caused by the Force of the Wind or Surge of the Sea when she is close hauled or plying to Windward, which makes her fall off and glide side-ways from the Point of the Compass she capes at, and must be allowed to be on the Right Hand of the Course steered when the larboard Tacks are on Board, and to the Left Hand when the starboard Tacks are on Board. The Allowances that are generally made are as follow:

1st. When a Ship is close hauled, if all her Sails be set, the Water smooth, and a moderate Gale of Wind; she is then supposed to make little or no Lee-way.

2dly. The Ship being upon a Wind, and the small Sails in, allow one Point for Lee-way.

3dly. The Wind blowing hard, so as to cause one Top-sail to be taken in, allow two Points for Lee-way.

4thly. When it blows so hard that both Top-sails are taken in, and the Sea runs high, allow then three Points for Lee-way.

5thly. The Fore-sail being furled, and the Ship tries under a Main-sail and a Mizzen, allow four Points for Lee-way; for she then makes her Way about four Points before the Beam, as the Sea Phrase is.

6thly. When the Ship tries under the Main-sail only, she then makes her Way about three Points before the Beam, that is, near five Points for Lee-way.

7thly. If the Ship tries under the Mizzen only, her Way is about two Points before the Beam; that is, allow six Points for Lee-way.

8thly:

8thly. When she lies a Hull, that is, with all her sails furled, her Way is one Point before the Beam, and then seven Points is her Lee-way.

9thly. When a Ship is lying-to under a Main-sail, Mizzen, &c. then observe how she comes up and falls off, and take the Middle between the two Points, and from that allow the Lee-way and Variation.

NOTE. In all Cases, Respect must be had to the Smoothness of the Water, or the Sea's running high, the Mould and Trim of the Ship, and then the Allowances may be rectified with the greater Certainty, by setting the Ship's Wake by a Compass placed on each Rail of the Ship's Quarter, which is usually set there for that Purpose.

For it is well known, that some Ship's with the same Quantity of Sail, and with the same Gale, will make more or less Lee-way than others; and also the same Ship, when she is out of her Trim, or differently loaded, will make different Lee-ways; for it is observable, that the more Water a Ship draws, the less Lee-way she makes; because she then meets with a greater Resistance in splitting the Water with her Side, than otherwise she would.

The Lee-way may be easily found by the Azimuth Compass, by turning the Instrument about until you see the Wake of the Ship either over the Sights, or parallel to them; then the Point of the Card, which is cut by the vertical Line in the Box, which is nearest to you, is the true Course; the Difference between that and the Course given by the Compass in the Binnacle, is the Lee-way required, which ought to be accordingly entered upon the Log-board.

There is another Way of finding the Lee-way, by fixing a Compass cut in Lead (or in other Metal) on the Poop, or some other convenient Part of the Ship's Stern, with the Meridian Parallel to the Ship's Side, and in the Centre a Pin is fixed, to which is fastened a small Line of a good Length, with a Piece of Wood at the End of it, that it may be dragged after the Ship. The Point or Degree cut by this Line will shew the Lee-way; if it cuts the Meridian the Ship makes no Lee-way; but if it does not, the Difference between the Meridian and where it cuts is the Lee-way.

By some of the above Methods the Lee-way (if there be any) ought to be carefully observed as often as may be judged necessary; and these Observations should be punctually set down by the Officer of the respective Watch; at least, if no Observation be made, he ought to set down the Lee-way according to his Judgment once or twice in the Watch, and by this Means the Course made good may be found to a much greater Certainty and Exactness than by the common Method of allowing for Lee-way, when the Day's Account comes to be worked, (which is generally once in twenty-four Hours:)

For

For an Observation must certainly be better than any Guess; but if no Observation be made, the Person who is upon Deck, and has the Care of the Watch, is better able to make proper Allowances, while Things are fresh in his Memory, and while he is an Eye Witness of the several Accidents that happen, and certainly much more capable than another who was not upon Deck during the whole Watch.

I have often admired to see how particularly every Thing is stated upon the Log-board, excepting the Lee-way; and yet that (which is one of the most material Articles, since the Course, according to the Compass, must be corrected by it,) only allowed for the next Day, according to every one's Fancy, thereby, as it were, keeping as many different Journals as there are Artists (so called) on board the Ship, and yet not one regular Journal properly amongst them all, since one of the most material Articles is only guessed at.

EXAMPLE I.

Suppose I steer N. E. by E. with my larboard Tacks on board, and make one Point Lee-way, then my Course made good is E. N. E.

Lee-way and Variation, when they are both to be allowed one Way, that is, both to the Right Hand, or both to the Left, add them together, and allow their Sum the same Way they were to be allowed.

But if they are to be allowed, one to the Right Hand, and the other to the Left, subtract the Less from the Greater, and allow the Remainder the same Way the Greater was to be allowed.

EXAMPLE II.

Suppose I steer N. N. W. with my starboard Tacks on board, and make one Point Lee-way, there being at the same Time half a Point Westerly Variation; I would know my true Course?

Lee-way to the Left Hand	1 Point.
Variation to ditto	$\frac{1}{2}$ Point.

Their Sum to be allowed to the Left Hand $1\frac{1}{2}$ whence

The true Course is N. W. by N. $\frac{1}{2}$ W.

EXAMPLE III.

Suppose I steer S. W. by W. with my larboard Tacks on board, and make two Points and an half Lee-way, and I have one Point and a quarter Westerly Variation, what is my true Course?

Lee-way to the Right Hand	$2\frac{1}{2}$ Points.
Variation to the Left Hand	$1\frac{1}{4}$ Points.

The Remainder to be allowed to the Right Hand $1\frac{1}{4}$ whence

The true Course W. S. W. $\frac{1}{4}$ Westerly.

EXAMPLE IV.

Suppose a Ship lying-to under a Main-sail, with her Starboard Tacks on board, comes up E. by S. and falls off to N. E. by E. there being one Point Westerly Variation, and she makes 5 Points Lee-way, what Course does she make good.

The Middle between E. by S. and N. E. by E. is E. by N. for which allowing 6 Points to the Left Hand, the true Course will be N. by E.

Currents, the Way they set you, and the Distance you suppose you are driven by them, is to be set in the Traverse Table for the Day, as any other Course and Distance.

EXAMPLE V.

Suppose I try the Current, and find it to set W. by N. per Compass one Mile per Hour, the Variation being one Point Easterly; then if I sail in that Current 24 Hours, I set down in the Traverse Table as a Course, W. N. W. Distance 24 Miles.

Heave of the Sea is to be accounted for in the same Manner as Currents: As, suppose there is a great Sea heaving towards the S. W. by my Compass, there being half a Point Westerly Variation, I then set down in my Traverse Table S. W. by S. half Westerly, with so much Distance as I judge the Sea has heaved the Ship.

At leaving the Land, the opposite Point to the Bearing, with the Variation allowed upon it, and the Distance you judge yourself from it, must be set down in the Traverse Table as a Course and Distance.

EXAMPLE VI.

Suppose having one and a quarter Point Westerly Variation, the Start bearing by my Compass N. N. E. distant four Leagues; the opposite Point to N. N. E. is S. S. W. which, with the Variation, makes S. $\frac{3}{4}$ Westerly, for the Course to be set in the Traverse Table distant 12 Miles.

When you make the Land your Bearing, itself (with the Variation allowed upon it) and the Distance you judge yourself from it, is to be set down in the Traverse Table as a Course and Distance. This needs no Example.

The Courses marked on the Log-board are the Courses steered by the Compass. In order to obtain the true Course, it is necessary to allow both for the Variation of the Compass, and for the Lee-way upon each Course on the Log-board, as has been shewn, before they are put into the Traverse Table:

Every Day, at Noon, the Log-board is to be transcribed into the Log-book, which is ruled exactly like the Log-board.

It is to be observed, that every Day's Account begins at the Noon of that Day, and ends at the Noon of the following Day, so that the Account of each Day, when finished, shews the Place of the Ship at the Noon of the following Day; and as the Observation made for finally settling any Day's Account is made at the End of that Day according to the Sailor's Way of Reckoning, that is, at the Noon of the following Day; therefore the Declination used in settling any Day's Latitude must be the Declination for the following Day in the Table of Declination. Thus, in settling my Latitude on Wednesday May 6th, or finding my Latitude at the Close of that Day, I use the Declination for Thursday May 7th.

There are various Methods of keeping a Sea Journal according to the Sentiments of various Persons with regard to what deserves being recorded: Some approve of a Journal including the Log-book, each Day's Work at some Length, and such Occurrences as seem of most Importance; while others prefer a short Abstract of this long Journal, containing little more than the Course run, the Latitude and Longitude in, and sometimes the Bearing and Distance of the intended Port for each Day.

In the following Journal the long Form is used as representing more fully each Day's Work, and the necessary Corrections; and an Abstract of this may be drawn out in the shortest Form that seems consistent with Distinctness. The Learner ought to be thoroughly acquainted with the long Form, and when he does that, he may either continue it, or take the shortest Form; or retrenching from the first, and adding to the second, what Particulars he thinks proper, and thereby make out a Form adapted to his own particular Taste.

Rules for correcting the Dead Reckoning by an Observation.

Notwithstanding the Rules already laid down for keeping a Ship's Way at Sea, yet by reason of the several Accidents that may attend a Ship in one Day's Run, such as swelling Seas, different Rates of sailing between the Times of heaving the Log, Want of Care at the Helm in letting the Ship yaw or fall off, accidental Currents, sudden Squalls, when no Account can be kept, &c. the Latitude by Account and Latitude by Observation may very often differ, then it is necessary that proper Corrections be made in the Difference of Longitude.

When you have made all proper Allowances you can, such as for Lee-way, Variation, Currents, &c. and still find that your Latitude by

by Account will not agree with your Latitude by Observation, then you must correct as follows :

First. Consider whether you have made proper Allowances for Currents, Heave of the Sea, if the Course at the Helm has been carefully attended to, if the Log-line and Half-minute Glass be just, and the Log properly hove, or any sudden Squalls, or proper Allowances made for the Lee-way, &c. which of these you conjecture your Error is in ; make what Allowances you think meet to your Difference of Latitude and Departure by Dead Reckoning, and see if that will reform your Latitude by Account, so as to make it agree with your Latitude by Observation ; if it does, you have guessed right ; (for you must always keep to the Latitude by Observation, it being the only Thing to be depended on) ; but if it will not agree with the observed Latitude, it is to be supposed that there are Mistakes in your Conjecture or some other Cause which produces the Error in the Reckoning, and stands in need of being corrected. In this Case you are first to examine your Log-line and Half-minute Glass, and if there be an Error in them, allow for it, as in the following Example,

E P A M P L E I.

Yesterday, at Noon, we were in Lat. $48^{\circ} 20'$ N. and till this Day at Noon we have sailed S. S. W. 48 Miles, S. W. by S. 36 Miles, N. E. 24 Miles, and find by a good Observation that we are in Lat. $47^{\circ} 14'$ N.

TRAVERSE TABLE.

Courses.	Diff.	N.	S.	E.	W.
S. S. W.	48		44.4		18.4
S. W. by S.	36		29.9		20.0
N E.	24	17.0		17.0	
		17.0	74.3 17.0		38.4 17.0
			57.3		21.4

By the Traverse Table it appears that by Account the Diff. of Lat. is 57.3 S. and the Departure 21.4 W.

Now the Lat. left was	$48^{\circ} 20'$ N.
Diff. of Lat. by Account	0 57 S.

Lat. in by Account	<u>47 23</u>
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Differing 9 Miles from the true Lat. by Observation.

Wherefore I examine the Log-line and Half-minute Glafs, and find that the former measures 52 Feet between Knot and Knot, and that the latter runs only 27 Seconds. Now as the Log-line and Half-minute Glafs are both faulty, I correct my Difference of Latitude and Departure as in CASE III. (Page 165) and find my correct Difference of Latitude 66.2 S. and my Departure 24.7 W.

Now from Lat. left $48^{\circ} 20' N.$

Take Diff. corrected for Error in Dist. $1 \quad 6 S.$

Lat. in, corrected for the Error in Dist. $47 \quad 14 N.$

Agreeing exactly with my Latitude by Observation: I therefore conclude my Reckoning sufficiently correct. Then with the Difference of Latitude $66^{\circ} 2'$, and Departure $24^{\circ} 7'$, together with Yesterday's Latitude, I find the Difference of Longitude either by Middle Latitude or Mercator's Sailing.

In the last Example 57.3 and 21.4 multiplied severally by 156, thrice the measured Length of a Knot, and divide the two Products by 135, five times the measured Time of the Glafs, will give the Difference of Latitude 66.2, and Departure 24.7, which is the same Thing as if every Course had been corrected separately.

EXAMPLE II.

Yesterday, at Noon, we were in Lat. $36^{\circ} 15' N.$ and have failed these 24 Hours S. E. $\frac{1}{2}$ E. 55 Miles, N. E. by N. 20 Miles, W. S. W. 70 Miles, S. by W. $\frac{1}{2}$ W. 20 Miles, and by Observation this Day at Noon we are in Lat. $34^{\circ} 56' N.$

TRAVERSE TABLE.

Courses. °	Dist.	N.	S.	E.	W.
S. E. $\frac{1}{2}$ E.	55		34.9	42.5	
N. E. by N.	20	16.6		11.1	
W. S. W.	70		26.8		64.7
S by W. $\frac{1}{2}$ W.	20		19.1		5.8
		16.6	80.8	53.6	70.5
			16.6		53.6
			64.2		16.9

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By the Traverse Table it appears that by Account the Diff. of Lat. is 64.2 S. and the Depart. 16.9 W.

Lat. failed from	36° 15' N.
Diff. of Lat by Account	<u>1 4 S.</u>

Lat. in by Account	<u>35 11 N.</u>
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Differing 15 Miles from the Lat. by Observation.

I now examine the Log-line and Half-minute Glass, and find them both right. Next I consider whether there be any Current, and I think I have Reason so suspect one: Upon Trial I find there is one setting S. S. W $\frac{3}{4}$ W. at the Rate of 7 Fathoms an Hour, and judge I have been in it these 24 Hours. Then 7 Fathoms (or Tenths of a Knot) per Hour, in 24 Hours, makes about 17 Miles; and to the Dist. 17 Miles, and Course S. S. W. $\frac{3}{4}$ W. the Diff. of Lat. is 14.6 S. and Depart. 8.7 W.

	Diff. Lat.	Dep.		
Now by Tra. Table	64.2 S.	16.9 W.	Lat. failed from	36° 15' N.
And by Current	<u>14.6 S.</u>	<u>8.7 W.</u>	Diff. of Lat. cor. for Cur.	<u>1 19 S.</u>
Correct for Cur.	<u>78.8 S.</u>	<u>25.6</u>	Lat. in correct. for Cur.	<u>34 56</u>

Which, agreeing with my Lat. by Observation, I conclude that my Reckoning is right; then having the Lat. left, and Lat. come to, the Diff. of Long. may be found either by Middle Lat. or Mercator's Sailing as before.

If after all proper Allowances are made for Errors in Distance, Currents; &c. the Lat. by Account and observed Lat. should disagree, then the Reckoning must yet be farther corrected; to do which the following are the common, and seem to be the most rational Methods.

C A S E I.

If the Course found by Dead Reckoning be less than 3 Points or 33 Degrees.

RULE. To the Diff. of Lat. and Dep. by Account find a Course; to this Course and the Diff. of Lat. by Observation, find the Diff. of Long. either by Middle Lat. or Mercator's Sailing.

E X A M-

E X A M P L E.

Yesterday, at Noon, we were in Lat. $39^{\circ} 18' N.$ by an Observation, this Noon we are in Lat. $37^{\circ} 48' N.$ and our Dead Reckoning gives 107 Miles of Southing, and 64 of Westing; required the true Diff. of Longitude?

To the Diff. of Lat. 107, and Dep. 64, I find the Course $2\frac{1}{4}$ Points; then with Meridional Diff. of Lat. between the two Observations 115, and the same Course, I find the true Diff. of Long. 69 Miles.

C A S E II.

If the Course found by Dead Reckoning be more than 3 Points, or 33° , and less than 5 Points, or 56° .

RULE. With the Diff. of Lat. and Dep. by Account, find the Distance; with this Distance, and the Diff. of Lat. by Observation, find another Departure. Take half the Sum of this Dep. and Dep. by Account, for the true Dep. with this Dep. and the Diff. of Lat. by Observation, find the Diff. of Long.

E X A M P L E.

Yesterday, at Noon, we were in Lat. $52^{\circ} 40' N.$ and are this Noon in Lat. $54^{\circ} 22' N.$ having by Account made 84 Miles of Northing, and 76 Miles of Westing; required the true Diff. of Longitude?

To the Diff. of Lat. 84, and Dep. 76, the Distance is 113 Miles, and the Course 48° .

To Dist. 113, and Diff. of Lat. between the two Observations 102, the Dep. is $47^{\circ} 7'$; then 76 added to $47^{\circ} 7'$ is $123^{\circ} 7'$, half of which is $61^{\circ} 8'$, the true Dep.

To Dep. $61^{\circ} 8'$, and Diff. of Lat. by Observation 102, the Course is 31° , and with the Course 31, and the Meridional Diff. of Lat. between the two Observations 171, I find the Diff. of Long. 103 Miles.

C A S E III.

If the Course by Dead Reckoning be more than 5 Points, or 56° .

RULE. With the Diff. of Lat. and Departure by Account find the Distance; then with this Dist. and Diff. of Lat. by Observation find the Diff. of Long.

E X A M P L E.

Yesterday at Noon we were in Lat. $38^{\circ} 52' N.$ to-day at Noon we are in Lat. $40^{\circ} 18' N.$ and by Account have made 68 Miles of Northing, and 112 Miles of Westing; required the true Difference of Longitude? With the Diff. of Lat. 68, and Depar. 112, I find the Dif. 132 Miles, and to Distance 132, and Diff. of Lat. by Observation 86, the Course $49^{\circ} 30'$ nearly; with this Course, and the Meridional Diff. of Lat. between the two Observations 111, the Diff. of Long. is 130 Miles.

The Reason of the above Rules is plain, if we consider, that when a Ship sails near the Meridian, it will require a sensible Error in the Course to make any considerable Error in the Difference of Latitude; which can hardly happen if proper Care is taken at the Helm; and therefore it is most likely, that the Error is in the Distance run; but when the Course is near the Middle of the Quadrant, or between 3 and 5 Points from the Meridian, it is then probable the Error may be in both the Course and Distance; and when the Course is more than five Points from the Meridian, it is then most likely the Error is in the Course, as it will require a great Error in the Distance to make any considerable one in the Difference of Latitude.

NOTE. As the true Place of a Ship depends upon its Lat. and Long. being truly ascertained, I have set these down only, the rest being of less Consequence to the Mariner.

To correct for several Days.

By help of the three preceding Rules, the Long. may always be corrected for a single Day, but if an Observation has been wanted for one or more Days, then mark the Lat. and Long. at last Observation, or if this be your first Observation since leaving the Land, mark the Lat. and Long. of the Land you left; this is the only Lat. and Long. you can call certain, all the following Part of the reckoning must undergo a Correction, which is made as follows.

Take the Northings, Southings, Eastings, and Westings, that you have made since your last Observation; or if it be your first Observation, then for every Day from your leaving the Land, minding not to leave out the Diff. of Lat. and Dep. of the Day you correct on, and bring them into a Traverse Table, by which you will have the whole Diff. of Lat. and Dep. by Account since the last Observation; and with that same Diff. of Lat. and Dep. find the Course by dead Reckoning, then observe which of the foregoing Cases that Course falls under, and correct by the Rule for that Case; or, which is still better, provided the Long. for each Day be truly found according to Account.

C A S E I.

Reckoning from the last certain Latitude and Longitude.

When the Course given by the Meridional Diff. of Lat. and Diff. of Long. by Account taken as Diff. of Lat. and Dep. is less than 3 Points, or 33 Degrees.

RULE. To the Mer. Diff. of Lat. and Diff. of Long. by Account (taken as Diff. of Lat. and Dep. as shewn in the Mercator's Sailing) find a Course, with this Course and the Merid. Diff. of Lat. by Observation, find a corresponding Dep. which will be the correct Diff. of Long.

E X A M P L E I.

Having failed three Days ago from Lat. $49^{\circ} 57' N.$ and got no Observation till this Day at Noon, and find I am in Lat. $45^{\circ} 23' N.$ and by Dead Reckoning I am in $45^{\circ} 12' N.$ having differed my Long. 173 Miles, required my true Difference of Longitude?

	M. Parts		M. Parts.
Lat. failed from $49^{\circ} 57' N.$	3470	Lat. failed from $49^{\circ} 57'$	3470
Lat. by Account $45^{\circ} 12' N.$	3047	Lat. by Obser. $45^{\circ} 23'$	3063
Merid. Diff. of Lat. by Acc.	<u>423</u>	Mer. Diff. of Lat. by Obs.	<u>407</u>

To Merid. Diff. of Lat. by Acc. 423, and Diff. of Long. by Acc. 173, the Course is $22^{\circ} 15'$. Then with the Course $22^{\circ} 15'$, and Meridional Diff. of Lat. between the Observation 407, I find the Diff. of Long. is 167 Miles.

C A S E II.

When the Course given by the Meridional Diff. of Lat. and Diff. of Long. by Acc. (taken as before) is greater than 3 Points, and less than 5 Points.

RULE. To the Merid. Diff. of Lat. and Diff. of Long. by Account, taken as Diff. of Lat. and Dep. find a Distance; with this Distance, and Merid. Diff. of Lat. by Observation, find a corresponding Departure; Half the Sum of this Dep. and the Diff. of Long. by Acc. is the correct Diff. of Longitude.

E X A M P L E II.

Three Days ago we were in Lat. $45^{\circ} 23' N.$ and have since that Time failed between South and West, have by Dead Reckoning altered

ed our Lat. 94 Miles, and our Long. 147 Miles; but by an Observation this Day, we find we are in Lat. $43^{\circ} 34'$; required the correct Diff. of Long.

	M. Parts.		M. Parts.
Lat. sailed from $45^{\circ} 23' N.$	3063	Lat. sailed from $45^{\circ} 23'$	3063
Lat. by Acc. $43 \quad 29 \quad N.$	2931	Lat. by Obser. $43 \quad 34$	2910
Merid. of Lat. by Acc.	<u>132</u>	Merid. Diff. by Obser.	<u>153</u>

With the Merid. Diff. of Lat. by Acc. 132, and Diff. of Long. by Acc. 147, I find the Distance 198, and Course 42° . Then to Distance 198, and Merid. Diff. of Lat. by Observation 153, the Dep. is 125, now 125 added to 147 is 272, and half this Sum, viz. 136, is the correct Diff. of Long.

C A S E III.

When the Course given by the Mer. Diff. of Lat. and Diff. of Long. by Acc. (taken as before) is more than 5 Points or 56 Degrees.

RULE. To the Merid. Diff. of Lat. and Diff. of Long. by Acc. (taken as Diff. of Lat. and Dep.) find a Distance.

To this Distance and Merid. Diff. of Lat. by Observation find a corresponding Dep. this Dep. will be the correct Diff. of Long.

E X A M P L E III.

Two Days ago I was in Lat. $43^{\circ} 34' N.$ and have since then made by Acc. 50 Miles of Southing, and 256 Miles Diff. of Long. West, but find by Observation, that I am in $42^{\circ} 30' N.$ what is my true Diff. of Long.

	M. Parts.		M. Parts.
Lat. sailed from $43^{\circ} 34' N.$	2910	Lat. sailed from $43^{\circ} 34'$	2910
Lat. by Acc. $42 \quad 44 \quad N.$	2841	Lat. by Obser. $42 \quad 30$	2822
Merid. Diff. of Lat. by Acc.	<u>69</u>	Mer. Diff. of Lat. by Obser.	<u>87</u>

Then to Merid. Diff. of Lat. by Acc. 69, and Diff. of Long. by Acc. 256 (taken as Diff. of Lat. and Dep.) the Distance is 265, and Course 73 Degrees.

And to Distance 265, and Diff. of Lat. 87 (the Merid. Diff. of Lat. by Observation) the Dep. is 250, which is the correct Diff. of Long.

Here we have given at some Length the different Methods of correcting the dead Reckoning by an Observation, which are readily done by the Table of Diff. of Lat. and Dep.

The Ship's Way is generally greater than the Distance given by the Log, and it is always safest to have the Reckoning a-head of the Ship, that the Mariner may be looking out for Land, and not make it before he is aware of it.

When a great Sea sets after the Ship it is common to allow one Mile over for every ten given by the Log for the Heave of the Sea; but if the Sea be against or athwart her, her Distance must be less than that given by the Log.

The Error in the Ship's Reckoning is frequently attributed to unknown Currents, for by various Causes yet undetermined; there are many counter Motions of the Water in the open Seas, as well as these observed near the Shores, where the Motions may be tolerably well accounted for; some of the observed Currents in the great Seas may perhaps be owing to the Tides following the Moon, and to the libratory Motion the Waters may have thereby, and the unsettled Setting and Drift of these Currents, may possibly depend on the Change in the Moon's Declination. However, it is well known from Observations, that the Trade Winds occasion a considerable Current within their Limits, particularly within the Torrid Zone, where the Motion is perpetually towards the West, at the Rate of 8 or 10 Miles a Day, but at the Extremities of the Trade Winds, or near the Latitudes of 30° N. or S. it is likely that the Currents are compounded of the said Western Motion, and of one towards the Equator; therefore, all Ships sailing within these Limits should allow a Course each Day for this Current.

NOTE. When the Difference of Latitude by Account is less than the Difference of Latitude by Observation, the Ship is a-head of the Reckoning, but if less, the Reckoning is a-head of the Ship.

When the Mariner is dubious of his Account of Longitude, he generally runs into the Latitude of the intended Port, and then sails E. or W. (if there be Sea Room) according as it is situated, and keeps a good look out for the Land.

The Method I have chosen to introduce the young Mariner into the most capital Part of Navigation is, by shewing him first how to work a few separate Days Works independent of each other, and then proceed to a continued Journal from London to Madeira, and back again to England, in which will be inserted most of the Occurrences that commonly happen at Sea or in Harbour.

I have seen many young Navigators who have been taught the Principles of Navigation on Shore, were very deficient in keeping a Journal at Sea; and, therefore, must request the Teacher not to omit putting the Pupils over the following Journal, which will render them ready at Working a Day's Work at Sea, and confirm in their Memory those Rules they have been over.

RULES FOR KEEPING A JOURNAL. 171

EXAMPLE I.

Yesterday Noon we were in the Latitude of $46^{\circ} 28' N$. Longitude $22^{\circ} 18' W$. and have sailed till this Day Noon, as by the Log board, the Tide having all the Time set S. by E. $2\frac{1}{2}$ Miles per Hour: Required the Ship's Place, and the direct Course and Distance made good?

August 7, 1774.

LOG-BOARD.						TRAVERSE TABLE.					
H.	F.	K.	Courses.	Winds.	Lee-way.	Courses.	Dist.	N.	S.	E.	W.
1	6	3	N. N. E.	W.		N. by E.	31	28.6		11.9	
2	6	2				E. N. E.	35	13.4		32.3	
3	6	5				E. by S.	36		7.0	35.3	
4	6	4				S. S. E.	51		47.1	19.5	
5	6	0				S. by E.	60		52.8	11.7	
6	6	1	E. N. E.	N. W.							
7	6	6						42.0	112.9	110.7	Dep.
8	5	8							42.0		
9	5	6									
10	5	4						D. Lat.	70.9		
11	5	5	E. by S.	N.							
12	5	3									
1	5	9									
2	6	2									
3	6	0									
4	6	3	S. S. E.								
5	6	4									
6	7	0									
7	6	8									
8	7	3									
9	7	5									
10	7	1									
11	7	9									
12	7	3									
						Dep. Lat.— $46^{\circ} 28' N$. M. Par.=3156					
						Diff. Lat.— 1 11 S.					
						Pref. Lat.— $45^{\circ} 17' N$. M. Par.=3054					
						Sum Lat.— $91^{\circ} 45'$ M. D. Lat.=102					
						Mid. Lat. — 45.52					
						Co. Mid. Lat. 44.08					
						Dep. Long. — 22.18 W.					
						Diff. of Long. — 2.39 E. or $2^{\circ} 40'$					
						Pref. Long. — 19.39 W.					
						Direct Course—S. $57^{\circ} 15'$ E.					
						Distance — 131 Miles.					

The Courses and Winds in the Log-board being examined, it appears that the Ship goes large, and has no Lee-way; therefore the several Courses from the Log-board are entered in the TRAVERSE TABLE without Alteration.

Next the Fathoms and Knots belonging to each Course are summed up, and the Results are put in the Column of Distances in the TRAVERSE TABLE; and to these Courses and Distances, the whole Difference of Latitude and Departure are found.

Then having the Latitude left, and the Latitude come to; find the Complement Middle Latitude, and with that, and the Departure, find the Course, &c. by MIDDLE LATITUDE SAILING.

Or with the Meridional Difference of Latitude find the Course, Difference of Longitude, by MERCATOR'S SAILING.

NOTE. When the odd Fathoms are above five, we allow one Knot, but if under five, nothing is allowed.

EXAMPLE II.

Being Yesterday Noon in Latitude $25^{\circ} 30' S.$ and Longitude $10^{\circ} 15' E.$ we have sailed 'till this Day Noon, as per Log-board, in a Current setting South $2\frac{1}{2}$ Miles an Hour, the Variation $1\frac{1}{2}$ Point West: Required the Ship's Place?

Sept. 7, 1773.

LOG-BOARD.						TRAVERSE TABLE.					
H.	K.	P.	Courses.	Winds	L. Way	Courses.	Dist.	N.	S.	E.	W.
1	6	0	S. W.	W. N. W.	I	S. by W. $\frac{1}{2}$ W	30		28.7		8.7
2	6	2				S. by E. $\frac{1}{2}$ E.	32		30.6	9.3	
3	6	4				S. $\frac{1}{2}$ E.	30		29.9	2.9	
4	6	0				S. E. by E $\frac{1}{2}$ E	39		18.4	34.4	
5	5	3				S. by E. $\frac{1}{2}$ E.	60		57.4	17.4	
6	6	0	S. by W.	W. by S							
7	5	1				Diff. Lat.	169.0	64.0	8.7		
8	5	4						8.7			
9	5	2									
10	5	3						55.3	Dep.		
11	5	5	S. S. W.	W.							
12	5	2				Diff. Lat. —	2° 45' S.				
1	5	2				Dep. Lat. —	25 30 S.	Mer. Parts	1583		
2	5	0						Mer. Parts	1768		
3	4	6				Pref. Lat. —	28 15 S.				
4	5	0					M. Diff. Lat.	189			
5	5	1	S. E. by S.	S. W. by S.							
6	5	2				Sum Lat. —	53 45				
7	5	4									
8	5	4				Mid. Lat. —	26 52				
9	6	0									
10	6	0									
11	5	4									
12	5	5									
						Co. M. Lat.	63 08				
						Long. left —	10° 15' E.				
						Diff. Long. —	1 02 E. or 1° 01' $\frac{1}{2}$ E.				
						Pref. Long. —	11 17 E.				
						Course is	S. 18° 30' E.				
						Distance	174 Miles.				

The Course and Winds in the Log-board being examined, it appears that the Ship is close hauled on each Tack, and one Point Lee-way being allowed reduces the Courses to S. W. by S., S. by W., S. E., and take a Course for the Current S. these several Courses being corrected by the Variation; 1½ Point West, give those in the TRAVERSE TABLE; to which the whole Difference of Latitude and Departure is to be found as before.

And hence the present Latitude and Longitude may be found, either by Middle Latitude or Mercator's Sailing ; for as the Ship is so near the Equator, the Difference will be almost insensible.

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EXAMPLE III.

Yesterday Noon we were in Latitude $33^{\circ} 40' N.$ Longitude $16^{\circ} 20' W.$, the Sun was observed to set $50^{\circ} 18'$ from the North Point of the Compass; we have sailed till this Day Noon, as per Log-board, in a Current setting W. S. W. $1 \frac{1}{2}$ Mile an Hour: Required the Ship's Place, and her Course and Distance to the West End of the Island of Madeira? June 4. 1773.

LOG-BOARD.				
H. K.	F.	Courses.	Winds.	L. Way
16	2	S. by W.	W.	
26	0			
36	3			
47	0			
57	2			
67	3			
77	2	S. W. by S.	W. b N	
87	2			
97	4			
107	6			
117	4			
128	1			
138	0			
28	5			
38	2			
47	5	S. W by W	N. W.	
57	3			
66	6			
76	4			
86	0			
96	2			
106	1			
116	3			
126	1			

TRAVERSE TABLE.					
Courses.	Dist.	N.	S.	E.	W.
S. $01^{\circ} E.$	40		40.0	0.7	
S. $10 W.$	70		68.9		12.2
S. $44 W.$	58		41.7		40.3
S. $55 W.$	36		20.6		29.5
	Diff. Lat.		171.2	0.7	82.0
					0.7
				Dep.	81.3

Before the Course can be corrected to put into the TRAVERSE TABLE, the Variation of the Compass must be found from the Sun's true Amplitude.

The Declination is $22^{\circ} 30' N.$

As Cos. $33^{\circ} 40'$: Rad. :: Sin. $22^{\circ} 30'$: Sin. $27^{\circ} 22'$.

So that the true Amplitude = $62^{\circ} 38' W.$

Mag. Amplitude = $50^{\circ} 18' W.$

Variation = $12^{\circ} 20' W$

The Courses in the Log-board being corrected by this Variation and the Lee-way, will give the Courses fitted for the Traverse Table.

Dep. Lat.	—	$33^{\circ} 40' N.$	Madeira's Lat.	—	$32^{\circ} 26' N.$	Mer. Parts	2058
Diff. Lat.	—	$2^{\circ} 51' S.$	Prof. Lat.	—	$30^{\circ} 49' N.$		1945
Prof. Lat.	—	$30^{\circ} 49' N.$	Diff. Lat.	—	$1^{\circ} 36'$		113
Sum Lat.	—	$64^{\circ} 29'$	Sum Lat.	—	$63^{\circ} 14'$		
Mid. Lat.	—	$32^{\circ} 14'$	Mid. Lat.	—	$31^{\circ} 37'$		
Co. Mid. Lat.	—	$57^{\circ} 46' N.$	Co. Mid. Lat.	—	$58^{\circ} 23'$		
Dep. Long.	—	$16^{\circ} 20' W.$	Madeira's Long.	—	$17^{\circ} 21' W.$		
Diff. Long.	—	$1^{\circ} 36' W.$	Prof. Long.	—	$17^{\circ} 56' W.$		
Prof. Long.	—	$17^{\circ} 56' W.$	Diff. Long.	—	$0^{\circ} 35' W.$		
			The Course	N. $17^{\circ} 15' E.$	Distance	101 Miles.	

In the Work for the Amplitude, the Latitude at Sun-set was taken the same as at Noon; for although there were about 46 Miles of Southing in that Time, and so the Latitude, at Sun-set, was about $32^{\circ} 54'$, yet the Amplitude being only about $15'$ less, the Alteration in Variation would scarcely affect the Difference of Latitude, and, Departure found from the Courses so corrected.

EXAMPLE IV.

Being Yesterday Noon in Lat. $19^{\circ} 30'$ S. Long. $0^{\circ} 10'$ E. This Forenoon we observed the Sun's Altitude to be $10^{\circ} 40'$ when he was $80^{\circ} 30'$ from the North Point of the Compass; we have sailed till this Day Noon, as per Log-board, in a Current setting by the Compass W. N. W. $\frac{1}{2}$ Mile an Hour. Required the Ship's Place, with her direct Course and Distance to the Island of St. Helena?

Aug. 3, 1773.

LOG-BOARD.

H.	K.	!	Courses	Winds.	Lee-way.
1	6	7	N.byE.	E.byN.	
2	6	2			
3	6	4			
4	6	3			
5	6	1			
6	6	0			
7	5	8	N.	E.N.E.	
8	5	4			
9	5	0			
10	5	3			
11	5	6			
12	5	9			
1	5	7			
2	6	4	N.NW	N.E.	
3	6	8			
4	7	0			
5	7	3			
6	7	6			
7	7	5			
8	7	0			
9	7	2			
10	7	4			
11	6	3			
12	6	0			

TRAVERSE TABLE.

Courses.	Dist.	N.	S.	E.	W.
N. $13^{\circ} 30'$ W.	38	36.9			8.9
N. $24^{\circ} 45'$ W.	38	34.5			15.9
N. $47^{\circ} 15'$ W.	76	51.7			55.6
N. $81^{\circ} 0'$ W.	12	1.9			11.8
		125.0			92.2
		D Lat.			Depart.

	$90^{\circ} 0'$		$90^{\circ} 0'$		$90^{\circ} 0'$
Declin. —	17 27	Lat.	19 30	Alt.	10 40
☉ D. from the Pole	107 27	C. Lat.	70 30	C. Alt.	79 20
				C. Lat.	70 30
The Half Sum	128 38			Sun's D.	107 27
Dist. —	107 27			Sum	257 17
Remainder	21 11			Half Sum	128 38
The Arith. Co. S. Co. Lat.	$70^{\circ} 30'$				0.0257
The Arith. Co. S. Co. Alt.	79 20				0.0072
The Log. of Half Sum	128 38				9.8935
The Log. of the Rem.	21 11				9.5579
				2)	19.4843
The Sine of Half the Az.	33 32				9.7421

From the North being doubled gives $67^{\circ} 4'$ the Sun's Azimuth from the North, and subtracted from $180^{\circ} 0'$, gives $112^{\circ} 56'$, the Azimuth from the South.

From the Magnetic Azimuth $80^{\circ} 30'$ N.
Take the true Azimuth $67^{\circ} 4'$ N.

The Variation — $13^{\circ} 26'$ W.

RULES FOR KEEPING A JOURNAL. 175

For the SHIP's Place.			For the Bearing and Dist. of St. Helena.		
Dep. Lat.	—	19° 30' S.	St. Helena's Lat.	—	16° 0' S. Mer. Parts 973
Diff. Lat.	—	2 5 N.	Pref. Lat.	—	17 25 S. 1061
Pref. Lat.	—	17 25 S.	Diff. of Lat.	—	1 25 88
Sum Lat.	—	36 55	Sum Lat.	—	33 25
Mid. Lat.	—	18 27	Mid. Lat.	—	16 42
Co.-Mid Lat.	—	71 33	Co.-Mid. Lat.	—	73 18
Dep. Long.	—	0 10 E.	St. Helena's Long.	—	5 53 W.
Diff. Long.	—	1 36 W.	Pref. Long.	—	1 26 W.
Pref. Long.	—	1 26 W.	Diff. Long.	—	4 27 = 267 Miles.
Course N. 71° 30' W. Distance 270 Miles.					

Here the Azimuth is worked with Yesterday's Latitude ; but had it been worked with this Day's, the Variation would have been 12° 30' the Diff. Lat. 126 M. and the Dep. 90 M.

In the following Journal are exemplified the Manner of allowing for the Variation, Lee-way, Lying-to, Calms, Currents, Heave of the Sea, &c. and to correct the Dead Reckoning by an Observation in all Cases, with most of the Occurrences that commonly happen at Sea.

A

JOURNAL of a VOYAGE

FROM

LONDON to MADEIRA,

In the NANCY, of LONDON, A. B. Commmander, kept by
T. WEIR, Mate.

Departure taken from the Lizard in Lat. 49° 57' N. Long. 5° 14' W.
Bound for Funchal, in Madeira, in Lat. 32 38 N. Long. 17 6 W.
Bearing from the Lizard Point S. 27° 1' W. Dist. 1156 Miles.

Wednesday

Wednesday May 23d.	At 5 A. M. the Pilot came on board; then we ghed and sailed from Cherry Garden. At 11 came to with the Best Bower * at Blackwall. Wind S. S. W.
Thursday 24th.	Fresh Gales and cloudy Weather, with Rain. At 5 A. M. weighed and sailed; and at 9 came to an Anchor at Gravesend, and cleared Ship. Wind from S. S. W. to N. N. W.
Friday 25th.	At 4 P. M. weighed and sailed, moderate Weather; at 9 came to with the Best Bower at the Nore in $9\frac{1}{2}$ Fathoms, fresh Gales; at 4 A. M. weighed and sailed; at 11 came to Anchor in the Downs in 7 Fathoms. Deal Castle bearing W. $\frac{1}{2}$ S. distant 3 Miles. Wind W. by S.
Saturday 26th.	At 1 P. M. sent the Pilot on Shore. These 24 Hours, the first and middle Parts moderate and fair, the latter Part strong Gales, and cloudy.
Sunday 27th.	Strong Gales and cloudy. At 2 P. M. veered out the Long Service† of the Best Bower, got Top-gallant Yards down. At 4 P. M. struck Yards and Top-masts. These 24 Hours had very hard Gales of Winds. Wind W. by S.
Monday 28th.	These 24 Hours for the most Part fresh Gales. At 4 A. M. hove up the Best Bower, and let go the Small Bower*. At 9 hove up the Small Bower, and let go the Best Bower again. People employed in making Points and Gaskets.
Tuesday 29th.	At 6 P. M. Strong Gales with heavy Rain. At 8 veered out the Long Service, and let go the Sheet Anchor under Foot. At 9 A. M. hove out the Sheet Anchor. Wind variable from S. by W. to W.
Wednesday 30th.	These 24 Hours for the first and middle Parts moderate and fair, the latter Part strong Gales. Wind W. by S.
Thursday 31st.	These 24 Hours fresh Gales and fair. At 3 P. M. got Top-gallant Mast down; at 10 A. M. got Yards and Top-mast up. Wind E. S. E.

* NOTE. It is customary in most Ships to have three Kinds of Anchors; namely,

The Small Bower used to fix the Ship in Still Water and calm Weather.

The Best Bower, a large Anchor for riding in rough Weather.

The Sheet Anchor, or largest, for fixing the Ship in stormy Weather.

† The first thirty Fathoms of Cable next the Anchor is called Short-Service, and when the remaining Part is veered out, it is called the Long-Service.

H.	K.	F.	Courfes.	Winds.	Lee-way.	REMARKS on board, Friday May 2d.
2			S. by W. $\frac{1}{4}$ W.	N. $\frac{1}{2}$ W.		At 2 P. M. hove short, and hoisted in the Long Boat.
4						At 4 weighed and failed in Co. with a 40 Gun Man of War, and 20 Sail of Merchant-men.
6						At 6 South Foreland bore N. N. W. dist. 4 Miles.
8						At 2 A. M. Fairlee bore N. dist. 6 Miles.
10						At 6 Beachy bore N. by W. 6 Miles.
12			W.	N. bW.		At 8 Beachy bore N. E. by E. 9 Miles.
2			S. W. bW. $\frac{1}{4}$ W.			Fresh Gales and clear, several Ships standing up Channel; close-reefed both Top-sails.
4			W. N. W. $\frac{1}{2}$ W.	N. $\frac{1}{2}$ W.		At 12 Bembridge Point before W. N. W. 27 Miles.
6			W. S. W.	N. by E.		Still in Company with the Fleet.
8						
10						
12						

[illegible]

H.	K.	F.	Courses.	Winds.	Lee-way.	REMARKS on board, Saturday May 3d.
2	0	0	W. S. W.	N. by E.		Fresh Gales and clear.
4	4	6	W. $\frac{1}{4}$ S.			At 4 P. M. parted with the Fleet, they being bound to Spithead. Dunnofe bearing W. N. W. distant 21 Miles.
6	5	5				At 5 let out one Reef of each Top-sail.
8	5	0				At 7 A. M. Portland Light bore W. N. W. 9 Miles.
10	5	1				At 10 A. M. bore N. E. 12 Miles.
12	4	6				14 Sail in Sight.
2	5	0				
4	4	4				
6	4	5				
8	4	4				
10	4	2	S. by W. $\frac{1}{2}$ W.	N. N. E.		
12	5	0				

[illegible]

H.		F.	Courses.	Winds.	Lee-way.	REMARKS on Board, Sunday May 4th.
2						These 24 Hours moderate Gales, and fair Weather.
4						
6						
8	4		S. W. by W.	N. E.		
10	4	5				At 6 P. M. the Lizard bore N. by E. Distance 6 Leagues from which I take my Dep. it being in the Lat. of 49° 57' N. and Longitude 5° 14' West of London. Unbent the Cables and stowed the Anchor. Several Sail in Sight standing to the Westward.
12	5					
2	5		S. W.			
4	5	5				
6	5	5				Variation 1 $\frac{1}{2}$ Point Westerly.
8	5	5				
10	5	5				
12	6					

Course.	Diff.	S.	W.	Lat. by D. R.	Lat. by Ob.	Mer. Diff.	Diff. Long.	Long. in.	Bearing and Dist.
S. 26° 38' W.	107	96	48	48.21 N.		0° 48'	73	6° 27' W.	Funchal S. 27° W. 109 Miles.

The Lizard bearing N. by E. Distance 6 Leagues from the Ship is the same as if the Ship, had sailed from the Lizard 6 Leagues or 18 Miles upon the opposite, or S. by W. Point of the Compass, and allowing for the Variation (as before taught) makes it S. $\frac{1}{2}$ E. Distance 18 Miles, which is to be set down as the first Course and Distance in the following Traverse Table.

The first Course steered by Compass is S. W. by W. which, allowing for the Variation, makes S. W. by S. $\frac{1}{2}$ W. and the Sum of all the Distances sailed on that Course till 2 o'Clock, when it alters is 18 $\frac{1}{2}$ Miles, which being doubled, because the Log is heaved every 2 Hours, gives 37 Miles; so the second Course and Distance to be set down in the Traverse Table is S. W. by S. $\frac{1}{2}$ W. 37 Miles. In like Manner the second Course steered is S. W. and the Variation allowed makes it S. S. W. $\frac{1}{2}$ W. and the Distances on that Course summed up and doubled gives 56 Miles; therefore the third Course and Distance to be set down in the Traverse Table is S. S. W. $\frac{1}{2}$ W. 56 Miles. Having found the whole Difference of Latitude and Departure made upon the several Courses, I then mark down upon my Slate or Paper what every Thing that is to be found comes to, and afterwards sets them down in their proper Columns as above.

TRAVERSE TABLE.					
Courses.	Diff.	N.	S.	E.	W.
S. $\frac{1}{2}$ E.	18		17.9	1.8	
S. W. by S. $\frac{1}{2}$ W.	37		8.6		23.5
S. S. W. $\frac{1}{2}$ W.	56		49.4		26.4
			95.9	49.9	
				1.8	
				48.1	

Now to Diff. of Lat. 95.9 S. and Dep. 48.1 W. the Course is S. 26° 38' W. Distance 107 Miles; then,
 Lat. sailed from, or Lizard's Lat. 49° 57' N.
 Diff. of Lat. 1 36 S.
 Lat. in, or Ship's Lat. 48 21 N.
 Sum of Lat. 98 18
 Middle Lat. 49 09

And to Middle Lat. 49° 9' and Dep. 48.1 the Diff. of Long. is 73.
 Long. sailed from, or Lizard's Long. 5° 14' W.
 Diff. of Long. 73 Miles = 1 13 W.
 Long. in, or Ship's Long. 6 27 W.

Now to find the Course and Distance to the intended Port?

		Mer. Parts.		
Ship's Lat.	48° 21' N.	3523	Ship's Long.	6° 27' W.
Funchal's Lat.	32 38 N.	2073	Funchal's Long.	17 6 W.

Diff. Lat. 943 Miles = 15 43 Mer. Diff. Lat. 1250 Diff. of Long. 639 Miles = 10 39

So from the Ship to Funchal the Course is found by Mercator's Sailing to be S. 27° 5' W. Distance 1059 Miles.

H.	K.	F.	Courfes.	Winds.	Lee-way.	REMARKS on Board Monday May 5th.
2	6		S. W. by W.	N.		This 24 Hours moderate Gales and cloudy Weather. At 4 P. M. spoke with the Charming Nancy from Carolina, bound to London.
4	5	5				
6	5			N. W.		
8	5					
10	4	6	S. W.			At Noon examined the Log-line and Half-minute Glafs used thefe 24 Hours, and found the Log-line to meafure only $44\frac{1}{2}$ Feet between Knot and Knot, and the Half-minute Glafs to run $28\frac{1}{2}$ Seconds.
12	4	4				
2	4	4				
4	4	5				
6	4	6				P.M. got the beft and fmall Bower Anchors on the Gunnel, and unbent the Cables and fowed them. Variation $\frac{1}{2}$ Wefterly.
8	5		S. W. by S.	W.NW		
10	4	5				
12	4					

Courfe.	Diff.	S.	W.	Lat. by D. R.	Lat.byOb.	Mer. Diff.	Diff. Long.	Long. in.	Bearing and Diff.
S. $29^{\circ} 42' W.$	107	93	53	46.48 N.		1.41 W.	1.19 W.	7.46	Funchal S. $26^{\circ} 44' W.$ 952 Miles.

The Variation being allowed upon each Courfe, and the Diffances fummed up as before taught, the Traverse Table and other Work will be as follows:

TRAVERSE TABLE.					
Courfes.	Diff.	N.	S.	E.	W
S.W. by S. $\frac{1}{2}$ W.	43	33.2			27.3
S. S. W. $\frac{1}{2}$ W.	45	39.7			21.2
S. by W. $\frac{1}{2}$ W.	27	25.8			7.8
		98.7			56.3

Now to Diff. of Lat. 98.7 S. and Dep. 56.3 W. the Courfe is $S. 29^{\circ} 42' W.$ Diff. 114 Miles, the Courfe and Diff. per Log.

But the Log-line and Half-minute Glafs being both wrong, the Diffance by Log muft be corrected by Cafe III. as follows:

$28.5 \times 5 = 142.5$ Then fay, as $142.5 : 1335 :: 114 : 107$
 $44.5 \times 3 = 133.5$ the true Diff.
 And to true Diff 107, and Courfe $29^{\circ} 42'$, the Diff. of Lat is 93 S. and the Dep. 53 W. the true Diff. of Lat, and Dep.

Lat. from, or laft Day's Lat.	48° 21' N.		
Diff. of Lat.	1 33 S.	Long. from, or laft Day's Long.	6° 27' W.
Lat in, or Ship's Lat.	46 48 N.	Diff. Long.	1 19 W.
Sum Lat.	95 09	Long. in, or Ship's Long.	7 46 W.
Middle Lat.	47 35		
And to Mid. Lat. $47^{\circ} 35'$ and Dep. 53, the Diff. of Long. is 79 Miles.			

Then for the Courfe and Distance from the Ship to Funchal.

		Mer. Parts.		
Ship's Lat.	46° 48' N.	3185	Ship's Long.	7° 46' W.
Funchal's Lat.	32 38 N.	2073	Funchal's Long.	17 6 W.
Diff. of Lat. 850 =	14 10	Mer. Diff. 1112	Diff. Long. 560 Miles =	9 20

Hence the Courfe and Distance from the Ship to Funchal is found as above.

H	K.	P.	Courfe.	Winds.	Lec-way.	REMARKS on board Tuesday May 6th.				
2	4		S. W.	W. N.W.		These 24 Hours moderate Gales, and clear Weather.				
4	4					At 6 P. M. saw a Ship to the Northward.				
6	4									
8	4	4	S.W. by S.	W. by N.	$\frac{1}{2}$					
10	4	5				Observed the Sun's Zenith Dist. at Noon $28^{\circ} 93' S.$				
12	4	6				Declination $17^{\circ} 01' N.$				
2	4	5				So the Latitude is $45^{\circ} 23' N.$				
4	4		S. S. W.	W.	1					
6	4									
8	4									
10	4									
12	4					Variation $1 \frac{1}{2}$ Point Westerly.				
Courfe.	Diff.	S.	W.	Lat. by D. R.	Lat. by Ob.	Mer. Diff.	Diff. Long.	Long. in.	Bearing & Diff.	
S. $8^{\circ} 30' W.$	97	96	14	$45^{\circ} 12' N.$	$45^{\circ} 23' N.$	1.55 W.	0.21	8.1	Funchal S. $28^{\circ} 51' W.$ 87.3 M.	

By allowing for the Variation on each Courfe as before, and the Lec-way on the two last Courfes, the Work will be as follows :

TRAVERSE TABLE.					
Courses.	Diff.	N.	S.	E.	W.
S.S.W. $\frac{1}{2}$ W.	24		21.2		11.3
S. by W.	36		35.3		7
S. $\frac{1}{2}$ E.	40		39.8	3.9	
			96.3	3.9	18.3
					3.9
					14.4

Now to Diff. of Lat. 96.3, and Dep. 14.4, the Course S. $8^{\circ} 30' W.$ Diff. 97 Miles.
 Lat. from, or last Day's Lat. $46^{\circ} 48' N.$
 Diff. of Lat. $1^{\circ} 36' S.$
 Lat. in by Account $45^{\circ} 12' N.$
 Sum Lat. $92^{\circ} 00'$
 Middle Lat. $46^{\circ} 00'$

To Middle Lat. 46° , and Dep. 14, the Diff. of Long. is 21 Miles.
 Long. from, or last Day's Long. $7^{\circ} 46' W.$
 Diff. of Long. $0^{\circ} 21' W.$
 Long. in by Account. $8^{\circ} 7' W.$

Here the Latitude by Observation differing 11 Miles from the Latitude by Observation, I correct for the true Longitude; and as this is the first Observation got since leaving the Land, I work as follows :

			Mer. Parts.			
Lizard's Lat.	$49^{\circ} 5' N.$		3470		To Mer. Diff. of Lat. 423, and Diff. of	
Ship's Lat. by Account	$45^{\circ} 12' N.$		3047		Long. 173, the Course is 2 Points; and to	
			<u>423</u>		Course 2 Points, and Mer. Diff. of Lat. 407	
Mer. Diff. of Lat. by Account					the Diff. of Long. is 167.	
Lizard's Lat.	$49^{\circ} 17' N.$		3470		Lizard's Long.	$5^{\circ} 14' W.$
Ship's Lat. by Observation	$45^{\circ} 23' N.$		3063		True Diff. of Long. 167	$= 2^{\circ} 47' W.$
			<u>407</u>		Ship's true Long.	$8^{\circ} 1' W.$
Mer. Diff. by Ob.					And to Course 2 Points, and Diff. of Lat. be-	
Lizard's Long.	$5^{\circ} 14' W.$				tween Lizard and Ship 274 the Distance is	
Ship's Long. by Account	$8^{\circ} 7'$				296 Miles.	

Diff. of Long. by Ac. $2^{\circ} 53' = 173$ Miles.

Hence the Ship has sailed from the Lizard S. S. W. 296 Miles, and the Course and Distance to the intended Port is found as above.

H.	K.	F.	Courfes.	Winds	Lee-way.	REMARKS on board Wednefday May 7th.
2	3	5	S. by W. $\frac{3}{4}$ W.	W.	1	Thefe 24 Hours moderate Gales and clear Weather.
4	3	5				
6	3	5				
8	3					
10	3	5				
12	3					P. M. fet up the Main and Mizen Top-Maft Shrouds and Back Stays.
2	3		S. by W.	W.byS.		
4	3					
6	3					
8	3					
10	3					
12	3					Variation is $1\frac{1}{2}$ Point nearly, or $13^{\circ} 48'$ W. per Ampl.

Courfe.	Diff.	S.	E.	Lat. by D. R.	Lat.byOb.	Mer. Diff.	Diff. Long.	Long. in.	Bearing and Diff.
S. 9° E.	76	75	12	$44^{\circ} 8'$ N.		$1^{\circ} 43'$	$6^{\circ} 16'$	$7^{\circ} 45'$ W.	Funchal S. $32^{\circ} 30'$, W. 817 Miles.

Allowing for the Variation and Lee-way as before, the Work will stand as under :

TRAVERSE TABLE.					
Courfes.	D.	N.	S.	E.	W.
S. $\frac{1}{2}$ E.	46		45 8	4-5	
S. by E. $\frac{1}{4}$ E.	30		29-1	7-3	
			74-9	11-8	

Now to Diff. of Lat. 74.9 S. and Dep. 11.8 E. the Courfe is S. 9° E. Diff. 76 Miles.

Lat. from, or laft Day's Lat.	$45^{\circ} 23' N.$
Diff. of Lat.	$1^{\circ} 15' E.$
Lat. in	
Sum Lat.	$44^{\circ} 8' N.$
Mid. Lat.	$89^{\circ} 31'$
	$44^{\circ} 45'$

And Co. Mid. Lat. $45^{\circ} 15'$ and Dep. $11^{\circ} 8'$, the Diff. of Long. is $16'$ E.

Long. from, or laft Day's Long.	$8^{\circ} 1' W.$
Diff. of Long.	$0^{\circ} 16' E.$

Long. in	$7^{\circ} 45'$
----------	-----------------

Having the Lat. and Long. in, the direct Courfe and Diff. to the intended Port is found (by Mercator's Sailing) as above.

H.	K.	F.	Courses.	Winds.	Lee-way.	REMARKS on board Thursday May 8th.
2	3	5	W. Handed	S. S.	3½	These 24 Hours hard Gales and squally, with small Rain.
4	3		Main-Sail.			
6	3		Handed Fore-	Sail,		
8	Lay	too	up N. W. by N.	off N. by E.		
10	Drift	1 ½	Mile per Hour		5	Saw a Ship to Windward with her Jury-masts up.
12	up	NW.	off N.		5	
2						
4						
6	Set	the	Fore Sail clofe	reefed,	and	Main-sail more moderate.
8	5		S. W.	NW bW ½ W	½	Set Top-sails clofe reefed.
10	5					
12	5					Variation 1½ Point Westerly.

Course.	Diff.	S.	W.	Lat. by D. R.	Lat. by Ob.	Mer. Diff.	Diff. Long.	Long. in	Bearing and Diff.
S. 81° 30' W.	25	4	25	44° 4' N.		2° 8'	35 W.	8° 20' W.	Funchal S. 31°, W. 800 Miles.

Taking the middle Point between the Point on which the Ship comes up, and the Point which she falls off for the second and third Courses, as taught in the Rules for lying-to, and then allowing as before for the Variation and Lee-way, the Traverse Table will stand as follows :

TRAVERSE TABLE.					
Courses.	Diff.	N.	S.	E.	W.
W. N. W. ¼ W.	21	7.1			19.8
N. N. E. ¼ E.	9	7.7		4.6	
N. by E. ¾ E.	9	8.5		3.0	
S. S. W. ¼ W.	30		27.1		12.8
		23.3	27.1	7.6	32.6
			23.3		7.6
			3.8		25.0

Now to Diff. of Lat. 3.8 S. and Dep. 25 W. the Course is 81° 30', W. Diff. 25 Miles.

Lat. from, or last Day's Lat. 44° 08' N.
Diff. Lat. 00 4 S.

Lat. in 44 04 N.
Sum Lat. 88 12
Middle Lat. 44 06

And to Middle Lat. 44.6, and Dep. 25, the Diff. Long is 35 Miles.

Long. from, or last Day's Long. 7° 45' W.
Diff. Long. 00 35 W.

Lat in. 8 20 W.

FROM LONDON TO MADEIRA. 183

H.	K.	F.	Courfes.	Winds.	Lee-way.	REMARKS on board Friday May 9th.
2				Calm.		The first 8 Hours calm and foggy. the rest stiff Gaies and clear.
4						
6						
8						
10	5	5	W. S. W.	S. $\frac{1}{2}$ E.	1	A Current all Day fetting N. W. by N. one Mile per Hour.
12	4	4				
2	4	6				
4	4	8				
6	4	6				
8	4	8				
10	4	8				
12	4	5				Variation $1\frac{1}{4}$ Point Westerly.

Courfes.	Diff.	S.	W.	Lat. by D. R.	Lat. by Ob.	Mer. Diff.	Diff. Long.	Long. in	Bearing and Diff.
S. 80° W.	84	15	83	43° 49' N.	43° 34' N.	3° 31' W.	2° 3'	10° 4' W.	Funchal S. 25° 12' W. Dist. 735 M.

The fetting of the Current and its Drift in 24 Hours being made a Courfe and Distance, as has been taught, and the Variation and Lee-way allowed for as before, the Work will be as follows :

TRAVERSE TABLE.						Now to Diff. Lat. 14.7 S. and Dep. 82.9 W. Courfe is S. 80° W. Dist. 84 Miles.	
Courfes.	Diff.	N.	S.	E.	W.		
S. W. by W. $\frac{3}{4}$ W.	72		30.8		65.7	Lat. from, or laft Day's Lat.	44° 4' N.
N. W. $\frac{1}{4}$ W.	24	16.1			17.8	Diff. Lat.	0 15 S.
						Lat. in	43 49 N.
		16.1	30.8		82.9	Sum Lat.	87 53
			16.1			Mid. Lat.	43 57
			14.7				

And to Mid. Lat. 43° 57', and Dep. 82.9, the Diff. of Long. is 115 Min.	
Long. from, or laft Day's Long.	8° 20' W.
Diff. Long.	1 55 W.
Long. in by Account	10 15 W.

But the Lat. by Observation differing from the Lat. by Account, I correct for the true Long. and as our laft Observation was three Days ago, I work as follows : (See RULE II. Page 167.)

		M. Pts.	
Last observed Lat.	45° 23' N.	3063	
Ship's Lat. by Account	43 49 N.	2931	
Mer. Diff. by Acc.		132	To Mer. Diff. by Account 132, and Diff. of Long. by Acc. 134, the Diff. is 190.
Last observed Lat.	45° 23' N.	3063	And to Diff. 190, and Mer. Diff. of Lat. by Obf. 153, the Diff. of Long. is 112.
Ship's Lat. by Ob.	43 34 N.	2910	Then 134 + 112 = 246, half this Sum 123 is the true Diff. of Long.
Mer. Diff. of Lat. by Observation		153	Long. at laft Obf.
Long. at laft Ob.	8° 1'		Diff. Long. 123 =
Ship's Long. by Account	10 15		Ship's true Long.
Diff. of Long. by Acc.	2 14 = 134 Miles.		

H.	K.	F.	Courfes.	Winds.	Lee-way.	REMARKS on board Saturday May 10th.				
2	4	5	W. S. W.	S.		Thefe 24 Hours moderate Gales with Showers of Rain. A great Swell from the S. W. for which I allow 6 Miles.				
4	4	5								
6	4	5								
8	4									
10	4									
12	4		S. W. by W.	S. by E.						
2	3	5								
4	3	5								
6	3	5								
8	3									
10	3					Variation 1 Point per Azimuth.				
12	3									
Courfe.	Diff.	S.	W.	Lat. by D. R.	Lat. by Ob.	Mer. Diff.	Dif. Long.	Long. in	Bearing and Diff.	
S. 53° W.	83	50	67	42° 44' N.		4° 38'	1° 33' W.	11° 37'	Funchal S. 22° 30' Diff. 657 M.	

In this Day's Work the Swell is to be considered as a Current, whose Drift in 24 Hours is 6 Miles, the Allowance made for the Swell; and as it comes from the S. W. it heaves the Ship towards the N. E. and the Variation allowed upon it makes last Course N. E. by N. as in the Traverse Table.

TRAVERSE TABLE.					
Courfes.	Diff.	N.	S.	E.	W.
S. W. by W.	58		32.2		48.2
S. W.	32		22.6		22.6
N. E. by N.	6	5		3.3	
		5	54.8	3.3	70.8
			5		3.3
			49.8		67.5

Now to Diff. of Lat. 49.8 S. and Dep. 67.5 W. Course S. 53° W. Diff. 83 Miles.

Lat from, or last Day's Lat.

43° 4' N.

Diff. Lat.

0 50 S.

Lat.

42 44 N.

Sum Lat.

86 18

Mid. Lat.

43 9

And to Mid. Lat. 43.9, and Dep. 67.5, the Diff. Long. is 93 M.

Long. from

10° 14' W.

Diff. of Long. 93 M.

1 33 W.

Long. in

11 37

H.	K.	F.	Courses.	Winds.	Lee-way.	REMARKS on board Sunday May 11th.				
2	4	5	W. by N.	S.W. bW.		These 24 Hours fresh Gales and clear Weather.				
4	4	5								
6	4	5								
8	5									
10	5		W. $\frac{1}{2}$ N.	S.S W $\frac{1}{2}$ W	$\frac{1}{2}$	Variation 1 Point Westerly.				
12	5									
2	5	5								
4	5	5								
6	5	5								
8	5	5								
10	5	5								
12	4									
Courses.	Dist.	S.	W.	Lat. by D. R.	Lat. by Ob.	Mer. Dist.	Diff. Long.	Long. in	Bearing and Diff.	
W.	120		120	42° 44'	42° 30'	6° 38'		14° 14'	Funchal S. 12°, W. 608 M.	

The Variation being allowed upon both Courses, and the Lee-way upon the second, it will be found that the Ship has sailed all this Day due West, or on a Parallel; and by summing the Distances up, they are found to be 120 Miles; which is also her Departure, and she has made no Difference of Latitude; consequently her Lat. by D. R. is the same as Yesterday, 42° 44' N.

As the Ship has sailed upon a Parallel, her Diff. of Long. must be found by Parallel Sailing; where-
 in Lat. 42° 44' to Dep. 120, the Diff. of Long. is $163 = 2^{\circ} 43' W.$
 Long. from, or last Day's Long. 11 37 W.
 Long. in by Acc. 14 20 W.

But the Lat. by Acc. differing from the Lat. by Observation, I must correct for the true Long. and as it is two Days since my last Observation, I correct it as follows:

		M. Pts.	
Lat. observed	43° 34'	2910	To Mer. Diff. of Lat. by Acc. 69, and Diff. of Long. by Acc. 256, the Dist. is 265.
Ship's Lat. by Account	42 44	2841	
		69	To Dist. 265, and Mer. Diff. of Lat. by Ob. 88, the Diff. of Long. is 250, the true Diff. of Long.
Lat. by Acc.			
Lat. observed	43° 34'	2910	Now Long. at last Ob. was 10° 4' W.
Ship's Ob. Lat.	42 30	2822	
		88	Diff. Long. 250 4 10 W.
Lat. by Ob.			
			Ship's true Long. 14 14
Long. at last Observation	10° 4'		
Long. by Account	14 20		
Diff. of Long. by Acc.	4 16	256 Miles.	

H.	K.	F.	Courses.	Winds.	Lee-way.	REMARKS on Board, Monday May 12th.			
2	8		S. S. W.	N.W. by W. $\frac{1}{2}$ W.		Stiff Gales and Showers till past Noon. From 2 P. M. fair Weather, and moderate Gales.			
4	8								
6	8	5							
8	8	5							
10	8	5							
12	8	5	S. by E. $\frac{3}{4}$ E.	S. W. $\frac{1}{4}$ W.	$\frac{1}{2}$	Variation 1 Point Westerly per Amplitude.			
2	9								
4	6								
6	5	5							
8	5	5							
10	5								
12	5								
Course.	Dist.	S.	W.	Lat. by D. R.	Lat. by Ob.	Mer. Dist.	Diff. Long.	Long. in.	Bearing and D
S.	175	175		39-46	39-40	6° 38'		14° 14' W.	Funchal S. 17° Dist. 440 Mil

TRAVERSE TABLE.					
Courses.	Dist.	N.	S.	E.	W.
S. by W.	118		115.7		23
S. S. E. $\frac{1}{4}$ E.	54		48.8	23.1	
			164.5	23.1	23
				23	
				0.1	

Proper Allowance being made for Variation and Drift, it appears from the Traverse Table that the Ship this Day made 164 Miles Southward, and no Departure wherefore her direct Course has been South, and her Latitude by D. R. 164. As she has made no Departure, her Longitude is the same as Yesterday, and for her Latitude,

Yesterday's Lat.
Diff. Lat. by Acc.
Present Lat. by Acc.

164

41° 30'
2 44
39 46

But as by Observation the Ship is found to be in 39° 40' North, it is plain she has got 6 Miles a-head of the Dead Reckoning, which 6 Miles being added to the Distance by Dead Reckoning, the Course, Distance, Difference of Latitude, and Longitude of the Ship for this Day, will be as in their respective Columns.

H.	K.	F.	Courses.	Winds	Lee-way	REMARKS on board Tuesday May 13th.			
2	8		S. S. W. $\frac{3}{4}$ W.	N.W. by N.	$\frac{1}{2}$	Fresh Gales and clear Weather. People employed with the Boatwain in mending the Mizzen-top-sail. Variation $\frac{3}{4}$ Westerly per Azimuth.			
4	8								
6	8	5							
8	8	5							
10	8								
12	8	5							
2	8	4							
4	8	4							
6	8	6							
8	8	6							
10	8	5							
12	8	0							
Courfe.	Diff.	S.	W.	Lat. by D. R.	Lat. by Ob.	Mer. Diff.	Diff. Long.	Long. in.	Bearing and Diff.
S. by W. $\frac{1}{2}$ W.	191	184	50	36° 29'	36.36	7° 28'	1° 11'	15° 25'	Funchal S. 37° W. Diff. 299 Miles.

By examining it appears, that by the Dead Reckoning the Ship's Courfe this Day has been S. by W. $\frac{1}{2}$ W. her Diff. 200 Miles, her Diff. of Lat. 191 Miles, and her Dep. 58 Miles; wherefore her Lat. and Long. by Acc. will be as follows :

Lat. from, or last Day's Lat.	39° 40' N.	And to Mid. Lat. 38.5, and Dep. 58, Diff.
Diff. Lat. 191	3° 11 S.	Long. is 74 M. = 1° 14' W.
Ship's Lat. by Acc.	36° 29 N.	Long. from 14 14 W.
Sum Lat.	76 09	Long. in by Acc. 15 28 W.
Mid. Lat.	38 05	

But by Observation the Ship is found to be in 36° 36' N. which, differing from the Lat. by Account, I correct as follows :

Yesterday's Lat.	39° 40' N.	To Courfe S. by W. $\frac{1}{2}$ W. and Diff. Lat. 184,
This Day's Lat. by Ob.	36 36 N.	Diff. is 192, Dep. 55.8, and to Mid. Lat. 38° 08',
True Diff. Lat.	3 04 = 184 M.	and Dep. 55.8, the Diff. Long. is 71 Miles.
Sum Lat.	76 16	Diff. Long. 71 = 1° 11' W.
Mid. Lat.	38 8	Long. at last Ob. 14 14
		Ship's true Long. 15 25 W.

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H	K.	F.	Courfes.	Winds.	Lee-way.	REMARKS on board Wednesday May 14th.				
2	4	3	W by S. $\frac{1}{2}$ W.	S. by W. $\frac{1}{2}$ W.	$\frac{1}{2}$	These 24 Hours moderate Weather with Rain.				
4	4	5								
6	4	7								
8	5		W. S. W. $\frac{1}{2}$ W.	S. $\frac{1}{2}$ W.						
10	5	2								
12	5	3								
2	5	5	W. S. W.	S.						
4	5	5								
6	5	4								
8	5	1								
10	5		S. W. by W.	S. by E.						
12	4	5								
						Variation $\frac{1}{2}$ P. W. per equal Altitudes of Sun.				
Courfe.	Diff.	S.	W.	Lat. by D. R.	Lat. by Ob.	Mer. Diff.	Diff. Long.	Long. in.	Bearing & Diff.	
S. 65 W.	119	50	108	35.52	35.46	9° 16'	2.13	17.38 W.	Funchal S. $\frac{1}{2}$ E. Dist. 190 M.	

Courses.	Dist.	N.	S.	E.	W.
W. by S. $\frac{1}{4}$ W.	27		4.0		26.7
W. S. W. $\frac{1}{2}$ W.	31		10.4		29.2
S.W. by W. $\frac{3}{4}$ W.	43		18.4		38.9
S. by W. $\frac{3}{4}$ W.	19		11.3		15.3
			44.1		110.1

Now to Diff. of Lat. 44.1 S. and Dep. 110.1 W. the Course is 68°, and Dist. 119.

Laft Day's Lat.		36 ⁿ	36' W.
Diff. Lat.	44	0	44 S.
Lat. in by Acc.		35	52 N.
Sum Lat.		72	28
Mid. Lat.		36	14

And to Mid. Lat. 36.14, and Dep. 110.1, the Diff.	
of Long. is	136 = 2° 16' W.
Last Day's Long.	15 25 W.
Ship's Long. by Acc.	17 41 W.

But by Observation the Ship is found to be in Lat. $35^{\circ} 46' N.$ differing from the Lat. by Account 6 M. the Ship has got so much before the Reckoning, I correct as follows :

Yesterday's Lat.	36° 36' N.	To Dist. 119, and Diff. Lat. 50, Course is 65°
This Day's Lat. by Ob.	35 46 N.	Dep. 108, and to Mid. Lat. 36° 11', and Dep.
True Diff. Lat.	0 50 M.	108, Diff. Long. is 133 M. = 2° 13' W.
Sum Lat.	72 22	Long. at last Ob. 15 25 W.
Mid. Lat.	36 11	Ship's true Long. 17 38 W.

Mid. Lat.	36	11	Ship's true Long.	17	38	W.
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H.	K.	F.	Courses.	Winds.	Lee-way.	REMARKS on board Thursday May 15th.			
2	4	6	S. by E. $\frac{1}{2}$ E.	S. W. $\frac{1}{2}$ W.	$\frac{1}{2}$	These 24 Hours moderate Gales and clear Weather.			
4	4	8							
6	4	8							
8	4	8							
10	5		S. S. E.	S. W.					
12	5	2							
2	5	3							
4	5	5	S. S. E. $\frac{1}{2}$ E.	S. W. by S $\frac{1}{2}$ W.					
6	5	5							
8	5	5							
10	5	6	S. E. by S.	S. W. by S.					
12	5	4				Variation $\frac{1}{4}$ Point Westerly.			
Course.	Diff.	S.	E.	Lat. by D. R.	Lat. by Ob.	Mer. Diff.	Diff. Long.	Long. in	Bearing and Diff.
S. 35. 30 E.	135	110	78.5	34.1 W.	33.56	7.58	1.36	16° 2' W.	Funchal S. W. by S. Diff. 94 M.

TRAVERSE TABLE.				
Courses.	Diff.	N.	S.	E. W.
S. S. E. $\frac{3}{4}$ E.	48		41.2	24.7
S. E. by S. $\frac{1}{4}$ E.	31		24.9	18.5
S. E. by S. $\frac{3}{4}$ E.	33		24.4	22.2
S. E. $\frac{1}{2}$ E.	22		14.8	16.3
			105.3	81.7

Now to Diff. of Lat. 105.3, and Dep. 81.7, Course is 38°. Diff. 133 Miles.

Last Day's Lat.	35° 46' N.
Diff. Lat. 105 M. =	1 45
Ship's Lat. by Acc.	34 01
Sum Lat.	69 47
Mid. Lat.	34 54

And to Mid. Lat. 34.54, and Dep. 81.7, Diff. of Long. is 100 Miles =
 Long. at last Ob. 17 38 W.
 Ship's Long. by Acc. 15 58 W.

But the Lat. by Observation differing 5 Miles from that by Account, I correct for the true Diff. of Long. as follows :

Yesterday's Lat.	35° 46' N.	74.4.
This Day's Lat. by Ob.	33 56	Then 74.4 + 81.7 = 156, Half is 78, = true Dep.
True Diff. Lat. 110 =	1 50	Then to Diff. Lat. 110, and Dep. 78, the Course is S. 35° 30' E. Distance 135 M.
Sum's Lat.	69 42	And to Mid. Lat. 34° 51', and Dep. 78, the Diff. of Long. is 96 M. =
Mid. Lat.	34 51	Long. at last Ob. 17 38 W.
		Ship's true Long. 16 02 W.

H.	K.	F.	Courses.	Winds.	Lee-way.	REMARKS on board Friday May 16 th .
2	5	1	W. by N.	S. W. by S.	$\frac{1}{2}$	These 24 Hours brisk Gales, and for the most Part foggy.
4	5					
6	4	9				
8	4	6	S. by E.	S. W. by W.		At 10 A. M. cleared up a little ; saw Funchal, bearing S. W. by S. Distance 4 Leagues.
10	4	4	S. by W.	W. by S.		At 10 P. M. came to Anchor off Funchal in 39 Fathoms.
12	4	8				
2	5	2	S. W. by S. $\frac{1}{2}$ W.	N. N. W. $\frac{1}{2}$ W.		
4	5	2				
6	5	1				
8	5					
10	4	7				
12						Variation $\frac{1}{2}$ Point.

Saturday
May 17th.

Wind
S. S. E.
with Rain

At 5 A. M. thinking we were too far to the Northward, hove up again, and gave the Ship a Sheer to the Southward, and anchored with the Best Bower in 35 Fathoms At 3 P. M. veered away upon the Best Bower, and moored a Cable each Way, the Best Bower W. N. W. and the Small Bower to the Eastward ; when moored, the Westernmost Point W. by N. the Loo-Rock N by W. Distance about $1\frac{1}{2}$ Miles, the Brazen Head E. by S. the Deserters from E. to S. E. Distance about 6 Leagues. Wind S. E.

Sunday
May 18th.

Frequent Squalls with Rain. At 7 P. M. hard Gales from S. W. with a large Swell ; got slip Buoy Ropes on the Cables, and all ready to put out to Sea. The People employed in knocking down the Beer Butts.

Monday
May 19th.

More moderate and clear. Set up the Bobstays, and stayed the Fore-mast ; cleaned the Ship fore and aft, and loosed the Sails to dry. Wind E. by N.

Tuesday
May 20th.

Sent sundry Bales of Goods on Shore, and received some Wine. Anchored here the Weasel Sloop and two India Ships. People employed in stowing the Wine. Wind E. S. E.

Wednesday
May 21st.

Continuing to get on board the Wine. Came to anchor here his Majesty's Ship Greenwich. Wind S. W.

Thursday
May 22^d.

Got up the Top-gallant Masts and Yards, and bent the Top-sails. Received on Board several Casks of Water and other Provisions for the Ship's Use. Wind W.

Friday
May 23^d.

At Day-light hove short on the Small Bower, and made a Signal for the Visiting Boat to come to clear the Ship. At 8 A. M. the Boat came ; at half past 10 weighed with light Breezes, and stood out to Sea under an easy Sail waiting for the Betsey, Captain Weir, Commander. At 11 she came up, and we proceeded on our Return towards England. Wind N. by E.

H.	K.	F.	Courses.	Winds.	Lee-way.	REMARKS on Board Saturday May 24th.			
2	8	6	N. by E. $\frac{1}{4}$ E.	E. by N. $\frac{1}{4}$ E.	1	At Noon, the West End of Madeira, bore S. W. by S. Dist. 17 Miles by Estimation, from which I take my Dep. it being in Long. $17^{\circ} 21' W.$ and Lat. $32.38 N.$ Fresh Gales and fair Weather throughout. In Company with the Betsy bound to London. Variation $1\frac{1}{2}$ West per Azimuth.			
4	9	0							
6	9	0							
8	8	5							
10	9	0	E. by N. $\frac{1}{2}$ E.	N.	0				
12	8	6							
2	8	5							
4	9	2							
6	8	4	N. N. E.	E. by N.	1				
8	7	6							
10	6	2							
12	5	1							
Cours.	Diff.	N.	E.	Lat. by D. R.	Lat. by Ob.	Mer. Diff.	X Lon.	Long. in.	Bearing and Dist. of the Land.
N. 20 E.	179	168	62	35. 26 N.		1° 2'	74	16.7 W.	Lizard N. $28^{\circ} 30' E.$ Dist. 990 M. Madeira S. 20 W. Dist. 179 M.

H.	K.	F.	Courses.	Winds.	Lee-way.	REMARKS on board, Sunday May 25th.			
2	10	0	N. by E. $\frac{1}{2}$ E.	E. by N. $\frac{1}{2}$ E.	1	Hard Gales and squally with Rain. By observing the Moon's Dist. from the Star Spica, the Long. was found to agree within 3 Miles with that under. Variation $14^{\circ} W.$			
4	9	6							
6	10	4							
8	10	0	W. N. W.	N.	1				
10	10	5							
12	9	8							
2	10	3	N. by E. $\frac{1}{2}$ E.	W. N. W.	0				
4	10	6							
6	11	7							
8	11	8							
10	11	4	W. $\frac{1}{2}$ N.	N. N. W. $\frac{1}{2} W.$	1				
12	11	6							
Cours.	Diff.	N.	W.	Lat. by D. R.	Lat. by Ob.	Mer. Diff.	X Lon.	Long. in.	Bearing and Dist. of the Land.
N. $34^{\circ} W.$	194	161	108	$38^{\circ} 7' N.$	38.7	0.46	135	18.22 W.	Lizard N. $38.15 E.$ 905 M. Madeira S. 13. W. 340 M.

MAY 24th

Courses.	Diff.	N.	S.	E.	W.
N. by E. $\frac{3}{4}$ E.	17	16.0		5.7	
N. $\frac{1}{2}$ W.	70	69.7			6.8
E. N. E.	71	27.2		65.6	
N. $\frac{1}{2}$ W.	55	54.9			2.7
		167.8		71.3	
				9.5	9.5
				61.8	

MAY 25th.

Courses.	Diff.	N.	S.	E.	W.
N. $8^{\circ} 30' W.$	60	59.3			8.9
S. $87^{\circ} 30' W.$	61		2.9		60.9
N. $3^{\circ} 00' E.$	89	88.9		4.7	
N. $70^{\circ} 30' W.$	46	15.3			43.3
		163.5			
		2.9	2.9	4.7	113.1
					4.7
		160.6			108.4

Having shewn how to keep a Journal the long Way, for the Benefit of the Learner, we shall now proceed to the Method commonly practised at Sea, which indeed is the same, only two Day's Work is contained in one Page.

H.	K.	F.	Courses.	Winds.	Lee-way	REMARKS on board, Monday May 26th.				
2	9	4	N. 61° E.	NN W.	o	These 24 Hours hard but steady Gales. At 4 P. M. set Fore-top-fail.				
4	9	6								
6	9	8								
8	9	8								
10	9	6				By drawing a Parallel through 40° 6' in the Variation, Chart, cuts the Variation Line in 14°, which con- firms the Ship's Account of Longitude.				
12	9	o								
2	9	4								
4	10	o								
6	10	o				Variation 14° West per Azimuth.				
8	10	o								
10	10	o								
12	10	o								
Course.	Dist.	N.	E.	Lat. by D. R.	Lat. by Ob.	Mer. Dist.	X Lon.	Long. in.	Bearing and Dist. of the Land.	
N. 59 E.	233	120	185	40.46	40° 06'	2° 19' E.	238 E.	14.24 W.	Lizard N. E. by N. 705 M. Madeira S. 15°, W. 4° 0 M.	

H.	K.	F.	Courses.	Winds.	Lee-way.	REMARKS on board, Tuesday May 27th.				
2	6	7	N. 1/3 E.	E.		These 24 Hours variable Winds and hard Gales, with cloudy and foggy Weather.				
4	8	o								
6	8	6	W. 1/4 N.	N. N. W.	I	Set Fore-top-fail.				
8	9	2				At 6 P. M. hard Fore-top-fail.				
10	8	5	E. by S.	N. E. by N.	I	A great Sea setting Southward, for which I allow half a Mile an Hour.				
12	8	5				Tried the Log-line and Glafs used this Day, and find only 45 1/2 Feet on a mean for the Length of each Knot, and 28 1/2 Seconds for the Run of the Glafs.				
2	8	6	N.	E.	o					
4	9	o								
6	9	4	W. by N. 1/2 W.	N. by W. 1/2 W.	2					
8	8	7				Set up the Main and Mizzen-stay and Shrouds.				
10	8	8	N. 1/4 W.	E.	o					
12	9	3				Variation 1 1/2 Point West.				
Course.	Dist.	N.	E.	Lat. by D. R.	Lat. by Ob.	Mer. Dist.	Diff. Lon.	Long. in.	Bearing and Dist. of the Land.	
N. 53 W.	74	45	59	40.51	40.52	3.18 E.	77	15.41 W.	Lizard N. 37° 45', E. 624 Miles. Madeira S. 6 30 W. 54 1/2 Miles.	

MAY 26th.

Courses.	Dist.	N.	S.	E.	W.
N. 47 E.	233	160		170	

There being 40 Miles Diff. between the Lat. by D. R. and Lat. by Obs. the Diff. of Long. must be corrected; and as the Course by D. R. is between 3 and 5 Points, I correct as follows:

To the Diff. of Lat. and Dep. by D. R. the Course is 47°, and Dist. 233; and to Dist. 233, and Diff. of Lat. by Ob. 120, the Course is 59°, and Dep. 199.7, which added to 170 is 369.7, Half is 185, the true Dep. and to Com. Mid. Lat. 39° 7', and true Dep. 185, the Diff. of Long. 238 = 1° 58', which subtracted from 18° 22' leaves 14° 24' the Long in.

MAY 27th.

Courses.	Dist.	N.	S.	E.	W.
N. by W.	29	28.4			5.7
W. S. W.	36		13.8		33.3
E. 1/4 S.	31		4.6	30.7	
N. by W. 1/2 W.	35	34			8.5
S. W. by W. 1/2 W.	36		18.5		30.9
N. N. W.	36	33.3			13.8
		95.7	36.9	30.7	92.2
		36.9			30.7
		58.8			61.5
Set of Sea	12				
	46.8				

In this Day's Work the Glafs and Log-line being both wrong I correct as follows:

$$28.5 \times 5 = 142.5, \text{ and } 45.5 \times 3 = 136.5.$$

Then say, as 142.5 : 136.5 :: 46.8 : 44.7 Diff. Lat. N.

And as 142.5 : 136.5 :: 61.5 : 58.9 the Dep. W.

With this Diff. of Lat. and Dep. the rest is found as above for March 4th.

H.	K.	F.	Courses.	Winds.	Lee way.	REMARKS on board, Wednesday May 28th.			
2	9	6	S. E. by E. $\frac{1}{2}$ E.	N. E. $\frac{1}{2}$ E.	2	Hard Gales and cloudy Weather, accompanied with Rain.			
4	9	2							
6	9	5	N. $\frac{3}{4}$ E.	S. W. $\frac{1}{2}$ W.	0				
8	8	5							
10	8	7	E. N. E. $\frac{1}{4}$ E.	N. $\frac{1}{4}$ E.	2				
12	8	2							
2	8	3	S. S. W. $\frac{1}{4}$ W.	N. $\frac{1}{4}$ E.	0				
4	8	7							
6	7	6	N. E.	N. N. W.	1 $\frac{1}{2}$				
8	7	2							
10	7	0							
12	6	4				Variation 1 $\frac{1}{4}$ Point W. per Amplitude.			
Cours.	Dist.	N.	E.	Lat. by D. R.	Lat. by Ob.	Mer. Dist.	X Lon.	Long. in.	Bearing and Dist. of the Land.
N. 46° E.	98	24	95	41.16	41° 16'	4° 53' E.	126 E.	13° 35' W.	Lizard N. E. by N. 624 M. Madeira S. 17° W. 546 M.

H.	K.	F.	Courses.	Winds.	Lee way.	REMARKS on board, Thursday May 29th.			
2	10	6	E. by N. $\frac{1}{4}$ E.	N. by E. $\frac{1}{4}$ E.	1	Hard Gales and squally, with Rain. Fore-fails close reefed.			
4	10	2							
6	11	0	N. N. E.	E.	1	At 11 P. M. spoke with the Dublin from Cork, bound to St. Mary's.			
8	10	3							
10	9	7							
12	9	6	E. by S. $\frac{1}{4}$ E.	N. N. E. $\frac{3}{4}$ E.	1	At Noon saw Cape Finisterre bearing E. $\frac{1}{2}$ N. Distance 25 Miles.			
2	10	2							
4	10	5							
6	10	8	N. E. $\frac{3}{4}$ E.	S. E. by E. $\frac{1}{4}$ E.	1				
8	10	0							
10	10	1							
12	10	6				Variation 1 $\frac{1}{4}$ Point West.			
Cours.	Dist.	N.	E.	Lat. by D. R.	Lat. by Ob.	Mer. Dist.	X Lon.	Long. in.	Bearing and Dist. of the Land.
N. 51° E.	185	117	144	43° 27'	43° 13'	7° 17'	194 E.	10.20 W.	Lizard N. 27° 13' E. 324 M. Madeira E. $\frac{1}{2}$ W. 903 Miles.

MAY 28th

Courses.	Dist.	N.	S.	E.	W.
S. E. $\frac{3}{4}$ E.	37		22.0	29.7	
N. $\frac{1}{2}$ W.	36	35.8			3.5
E. by N.	34	6.6		33.6	
S. by W.	34		33.6		6.6
N. by E. $\frac{1}{4}$ E.	56	37.6		41.5	
		80.0	55.6	104.8	10.1
		55.6		10.1	
		24.4		94.7	

MAY 29th.

Courses.	Dist.	N.	S.	E.	W.
E. by N.	42	8.2		41.2	
N. $\frac{1}{2}$ W.	62	61.9			3.0
E. by S.	61		12.1	60.8	
N. N. E. $\frac{1}{2}$ E.	33	73.2		39.1	
		143.3	12.1	141.1	
		12.1		3.0	
		131.2		138.1	

On May the 29th, the Lat. by D. R. having out-run the Lat. by Ob. the Dep. must be corrected; and as the Diff. of Lat. and Dep. by D. R. are nearly equal, I correct as follows:
To Diff. of Lat. 131.2, and Dep. 138.1, the Diff. is 190. To Diff. 190, and Diff. of Lat. by Ob. 117, the Dep. is 149.0, which added to 138.1 is 287.8, Half is 143.9, the true Dep. with which, and the true Diff. of Lat. 117, the rest are found as above.

H.	K.	F.	Courses.	Winds.	Lee-way.	REMARKS on Board Friday May 30th.				
2	9	2	N. $\frac{1}{2}$ W.	S. S. E.	o	Hard Gales and clear Weather.				
4	10	0				At 6 P. M. clove reefed the 1 st Sail.				
6	9	5				At 6 A. M. saw a Sail to Northward.				
8	10	0								
10	10	6								
12	10	2								
2	10	4				Lat. by double Altitudes as under.				
4	9	6								
6	10	0								
8	10	4								
10	9	8								
12	10	0				Variation $1\frac{1}{2}$ Point West.				
Cours.	Diff.	N.	W.	Lat. by D. R.	Lat. by Ob.	Mer. Diff.	Diff. Lon.	Long. in.	Bearing and Dist. of the Land.	
N. N. W.	260	239	99	$46^{\circ} 55'$	$47^{\circ} 12'$	$5^{\circ} 38' E.$	141 W.	$12^{\circ} 41'$	Lizard N. E. by E. $\frac{1}{2}$ E. 324 M.	

H.	K.	F.	Courses.	Winds.	Lee-way.	REMARKS on board, Saturday May 31st.				
2	7	6	E.	N. by E.	o	Stiff Gales and drizzling Rain.				
4	8	4				At 7 A. M. spoke with the Hamilton, Moon from Carolina, bound to London.				
6	8	6				Bent the Sheer, P. M. and sent Bower Cable and got the Anchor clear.				
8	8	9								
10	9	0								
12	8	6								
2	8	3				Lat. by Meridian Altitude as under.				
4	8	4								
6	8	1								
8	8	6								
10	8	3								
12	8	0				Sounded 80 F. brown Shells and Gravel. — Variation $1\frac{1}{2}$ Point W.				
Cours.	Diff.	N.	E.	Lat. by D. R.	Lat. by Ob.	Mer. Diff.	Diff. Long.	Long. in.	Bearing and Dist. of the Land.	
N. 77 E.	202	46	196	$48^{\circ} 11'$	$47^{\circ} 56'$	$8^{\circ} 54' E.$	288	$7^{\circ} 53'$	Lizard N. 41° E. 152 M.	

Courses.	Diff.	N.	S.	E.	W.
N. N. W.	240	221.8			91.8

Courses.	Diff.	N.	S.	E.	W.
E. by N. $\frac{1}{2}$ N.	202	58.6		193.3	

There being 17 Miles Difference between the Lat. by Account and Lat. by Observation, I must correct; and as the Course is 2 Points, I must correct by Case I. Then to the same Course, and Diff. of Lat. by Obs. the Dist. is 260, and Dep. 99.53; with which, and the Co. Mid. Lat. the Dist. of Long. is found as above.

Here, the Lat. by D. R. differs 13 Miles from the Lat. by Obs. and as the Course by D. R. is more than 5 Points, I must correct by Case I. To Diff. of Lat. 58.6, and Dep. 196.5, the Distance is 202; and to this Dist. and Diff. of Lat. by Obs. the Course is 77° , and Dep. 193.3, with which, and Co. Mid. Lat. $42^{\circ} 55'$, I find the Dist. of Long. is 288 Miles East.

H.	K.	F.	Courfes.	Winds.	Lee-way.	REMARKS on board Sunday June 1st.
2	7	6	E. by N. $\frac{1}{2}$ N.	W. S. W.	o	These 24 Hours, first Part moderate Gales and clear Weather, the latter Part foggy. At 10 A. M. cleared up and saw the Lizard bearing N. $\frac{1}{2}$ E. Distance 7 Leagues.
4	7	0				
6	6	0				
8	6	4				
10	6	2				
12	7	5				
2	7	0				
4	7	3				
6	7	1				
8	5	6	N. N. E.	Foggy.		
10						
12						

Monday June 2d.	Light Breezes. At 6 P. M. the Start bore E. by N. the Ram's-head N. 36° , W. the Bolt-head N. by E. Distance from the Start 6 or 7 Miles. At Noon, the Start E. by N. $\frac{1}{2}$ N. distant 4 or 5 Miles. 35 Fathoms Water. Lat. $50^{\circ}05' N.$ Several Sail in Sight. Wind N. N. E.
Tuesday June 3d.	Mostly calm, the Remainder light Airs. At 1 A. M. passed his Majesty's Ship the Rainbow. At 2 P. M. came a Boat from Shore with a Pilot, who took charge of the Ship; by the same Boat sent away one Hoghead of Wine. At Sun-set the Eddystone bore N. $\frac{1}{2}$ E. distant about 3 or 4 Leagues. At Noon the Ram-head bore N. by W. $\frac{1}{2}$ W. the Bolt E. $\frac{1}{2}$ S. Stood in for the Sound with light Airs at S. At 5 P. M. anchored. Saluted the Admiral with 13 Guns, and moored with the Best Bower and Stream Anchors. Wind N. E.
Wednesday June 4th.	Light Breezes. At Noon unmoored Ship, and hove short on the Stream Cable. At 2 P. M. weighed, and run into Hamoafe At half past 4 took in the King's Moorings, and at 6 P. M. the Captain went ashore with Letters to the Merchants. Wind S. E.

Having treated at some length of the Method of keeping a Ship's Way at Sea, which was thought necessary to render the young Artift expert therein, as it is the principal Part which a Number of dry Problems would never do, I shall next proceed to shew how to work a Ship; and though the Terms and Language may seem uncouth to the Learner, yet it is presumed they will not be so to the more experienced Seaman.

The Substance of that Examination, which every Candidate for a Commission in the Navy or East-India Service, must necessarily pass, previous to his Appointment, respecting the Management of a Ship, from her first coming out of Dock to her clearing the Land, with Directions for working a Ship in all difficult Cases at Sea.

Ques. **S**IR, you appear here to be examined in your Abilities, necessary to qualify you for being appointed an Officer in the Ship ———, Captain ———, now bound to India, in the Company's Service—a great Charge. What do you look upon to be your Duty in that Capacity?

A. When I have received my Captain's Commands, I am then not only to direct, but likewise to inspect into every thing relative to such Orders, and see it properly executed accordingly.

Q. When your Ship is out of Dock, what is first to be done?

A. After the proper Officers have examined the Limbers, I would level the Hold, by laying the Kentledge from the Fore-part of the Fore-hatchway to the After-part of the After-hatchway.

Q. If you are taking in Bales, how high would you dunnage, and what Part of the Ship most?

A. I would dunnage six Inches, and mostly about the Well and Main-hatchway, and the Wake of the Chains and Floor Timbers.

Q. Suppose you have one and a half Foot Water in your Hold, and your Ship heels four Streaks down; what Dunnage ought you to have, to preserve the Cargo?

A. Three Feet.

Q. How would you moor your Ship at Gravesend?

A. I would come-to with my small Bower, veer the Service into the Hawse, and then hang my best Bower in the Long-boat, and with the Tide drop her a-stern; and, when the Cable is taught, let go the Anchor.

Q. You have been in the Downs: how do you moor there?

A. With my best Bower to the S. W. upper Deal-mill and Deal Castle in one, with the South-Foreland S. W. by S. in eight Fathoms; I would veer away with the last quarter Flood, and moor with the same Bower to the N. E.

Q. Where is the best anchoring in the Downs?

A. Bring upper Deal Church in one with Deal Castle, and anchor in eight or nine Fathom Water.

Q. What are the Marks for anchoring in the Downs, Deal Castle bearing West?

A. The South Foreland S. W. and Sandown Castle N. N. W.

Q. How would you unmoor in the Downs with the Wind at North?

A. I

A. I would splice my Stream-cable to my small Bower, and veer away at half Ebb, that I might have Time to stow my best Bower, and shorten in my small Bower-cable before the Ship tends to Windward; but as soon as the Tide slack, if I was afraid to trust my Stream-cable, I would veer on my best, and take up my small Bower.

Q. Suppose the Wind northerly, you were in a Ship's Hawse in the Downs?

A. I would wait till the Ship tended to Windward, and heave-to my Anchor as she tended to it.

Q. How would you work the Ship out of the Downs with the Wind southerly?

A. I would come no nearer the Goodwin than thirteen Fathoms Water, nor to the Main than eight or eight and a half Fathoms; when I come near the Foreland, into no less than ten fathoms; there is a Shoal off West Castle, fourteen Feet at Low-water, bearing E. about two Miles.

Q. If it blows hard in the Downs at S. W. and you part your Cables, what would you do?

A. I would stand out to the Goodwins till I brought the South Foreland Light to S. W. by S. then, keeping in nine Fathoms Water, steer N. N. E. till the North Foreland Light bore W. N. W. when I might safely hawl round for Margate Roads.

Q. How do the Forelands bear of each other?

A. Nearest North and South.

Q. How does the Tide flow in the Downs?

A. By the Shore S. S. E. and in the Offing S. E. by S.

Q. What are the Marks of the Goodwin, by which you are to know when you are clear of them?

A. The Goodwin Sands are two large Quick sands, called the North and South Sands. When upper Deal Mill and Warner Castle are in one, then I am a-breast the South Sand-head; and when the North Foreland bears N. W. by W. I am a-breast the North Sand-head.

Q. Suppose you were riding at Anchor in the Downs, and an express Order came for you to go to the Westward with the Wind at S. W. or S. S. W. at what Time of the Tide would you unmoor?

A. I would unmoor at Half-flood, to be in Readiness to weigh at High-water, and cast her in-shore, (by reason of the Tide being sooner done in-shore) if Room; if not, I would tack and stand off in ten or eleven Fathom Water, then stand in to the Shore in seven Fathoms, and lay my Top-sails back till my Anchors were stowed.

Q. Is there any Danger in going off the Down? In what Water would you stand in Shore, and what Water towards the Goodwins?

A. Yes;

A. Yes; between Deal and Warner Castle there are some Shoals, with, at Spring-tides, not above sixteen or seventeen Feet Water at Low-water. I would come no nearer the Shore than six Fathoms; and no nearer the Goodwin-sands than ten or eleven Fathoms; in some Places the nearer I go to the Sands I should have the deepest Water; but then there would soon be so little water, that I should be aground before I could perceive its Shoal, I would, therefore, stand towards the South Foreland in nine Fathoms, and to the South Sand-head in seven Fathoms, there being gradual Soundings.

Q. What are the Marks for running through the Gulph Stream?

A. To keep the Light-house on the South Foreland in one with the westernmost End of the southernmost Clift in Old Stains Bay.

N. B. Stains Bay is the Swamp that lies between two Clifts, which lies a large Half-mile to the Southward of Kingsdown upon the South Foreland.

Q. What are the Marks of the Dangers going out of the Downs?

A. Upper Deal Mill in one with the Corner of Warner Castle, will lead me clear off. Upon Deal Church being open with the said Castle about a Ship's Length, I must stand out so till I bring the Light-house in one with the Castle, and then I shall be abreast of the South Sand-head; and, when the Light-house opens to the Westward of Folkestone Church with Hay Clifts, it leads me clear. I must observe not to shut in the Hope-land E. by N. and the South Sand-head will lie off a full League.

Q. Suppose you were coming into the Downs, with the Wind at West blowing hard, which Way would you lay your Ship's Head to?

A. I would come-to with my best Bower, and lay my Ship's Head to the Eastward; but if with the small Bower, I would lay her Head to the Westward.

Q. For what reason would you do so?

A. Because I should thereby keep my Cable clear of the Cut-water.

Q. What is the Course from the South Foreland to Dungeness? and what are the Dangers?

A. From the South Foreland to Dungeness the Course is S. W. by W. Distance nine Leagues: the Dangers between them are the Ripraps; the shoalest Part of which lies from Dover S. four Leagues; from Calais Clifts W. by S. from Folkestone S. E. and E. S. E. four Leagues: from Dungeness it lieth in Length N. E. and S. W. Distance about four Leagues, both Ends pointing to the English Shore; it is very narrow, and has on it but fifteen Feet at Low-water: I would come no nearer than twenty fathoms. When the Neefs bears N. W. by N. I am to the Northward of it: it flows at the Ripraps N. E. and S. W. that the Tide runs to the Eastward till Three o'Clock Full and Change, when it is half-ebb by the Ground.

Q. How

Q. How would you come to an Anchor under Dungeness?

A. I would bring the Nefs Point to bear S. W. by S. or S. W. half S. in nine Fathoms: in passing it I would come no nearer than twelve or fourteen Fathoms: I would anchor to the West, with the Point E. or E. by S. in nine or ten Fathoms.

N. B. It flows at the Nefs S. E. by S. and N. W. by N. the Tide runs to the Eastward till Two o'Clock Full and Change.

Q. What is the Course from Dungeness to Beachy Head? and what Dangers are there?

A. From the Nefs to Beachy the Course is W. S. W. Distance eight or nine Leagues: there is a Shoal between them called Penvensey Sand; and has on it at Low-water and Spring, not twelve feet; it lays about E. by N. from Beachy, and S. half W. from Penvensey Castle, Distance from the Shore about two Miles.

N. B. It flows off Beachy and in the Offing N. by W. eleven Hours, and S. by E. eleven Hours.

Q. Suppose you were off Beachy Head, bound down the Channel, and the Wind came to the South; what would you do?

A. As the Variation is in my Favour, I would trim all sharp, and stand to the Westward, and I judge, if it did not over-blow, I should clear all.

Q. Being off Beachy Head with a Gale of Wind at N. E. bound to Spithead, and at the Close of the Evening, what is best to be done?

A. I would lie to with my Ship's Head to the N. N. W. till Morning, then she would drive about a Channel Course, at the Rate of two Miles an Hour, allowing what she would lose on the ebb, she would gain on the flood, and be in a fair Way in the Morning; I must come no nearer the Oars, than eighteen or nineteen Fathoms.

Q. In case you were bound down the Channel, and the Wind blows fresh at N. E. how would you unmoor your Ship?

A. I would veer away upon my best Bower; the wind would set the ship a-head, and ease my heaving in my small Bower.

Q. In sailing from Beachy to the Isle of Wight, what Course would you steer, and what Dangers are there?

A. The Course is W. by S. Distance sixteen or seventeen Leagues. The Dangers between them are the East Borough-head, which lies from Arundel S. S. W. seven miles, and the Oars which lie from Chichester Church S. S. E. four Leagues. The leading Marks to carry you clear of the Oars, are Dunnose Point W. or W. by N. and Culver Cliffs N. W. by W. or W. N. W. when Chichester Church bears W. by N. I am to the Northward of the Oars.

Q. What are necessary to be observed in sailing into Spithead?

A. If I were bound into Spithead, after I am to the Westward of the Oars, I would steer N. W. by W. or W. N. W. and open Sandown Castle with the Culver Cliffs, till I could see St. Helen's Church

Church a Sail's Breadth or two, open with the Bed Cliffs of Bembridge Point, and that will clear the Ledge; then by steering N. W. for the Buoys, I should see the Gilkickers, must keep them in one, and that will lead me between the Buoys of the Warners and of the Dean, and then on Portfdown I shall see a large Chalk-pit, that and South-sea Castle in one, will lead me clear up to Spithead, between the Buoy of the Horfe and No-man's Land.

Q. In turning into Spithead, what do you observe, and how do you come to an Anchor there?

A. I may open the Kickers each way, but in case a Fleet be at Spithead that should obstruct the Sight of them each Way from me, there is a Mark on the Top of the Down on the Wight; by keeping that open above the Trees, it will carry me clear up to Spithead; and when the said Mark bears S. W. or S. W. by S. I am abreast of the Horfe: I must come no nearer to it than seven Fathoms; nor to No-man's Land than twelve or thirteen Fathoms. I would anchor at Spithead with the Kickers N. W. the Ride W. S. W. and South-sea Castle E. by N. or E. N. E. in eight, nine, or ten Fathoms.

Q. How would you come to an Anchor at St Helen's?

A. I would keep Sandown Castle just open with the Culver Cliffs, till I should bring St Helen's Church a Sail's Breadth open of the Red Cliffs of Bembridge Point, or Ledge, (there are six or seven Fathoms Water) and anchor with the Church on the S. W. by W. or W. S. W. in eight or nine Fathoms.

Q. Suppose you were moored at Spithead, with a Cable and a Half on the best Bower, and one on the small Bower, and you have orders to sail; at what Time of Tide would you unmoor? and which Anchor would you take up first?

A. I would begin to unmoor at the first of the Flood, and take up my small Bower first.

Q. In sailing round the Wight, what are your Observations?

A. To keep clear of Ride Middle, I would keep South-sea Castle a Sail's Breadth open of the Kickers, till I open West Cowes Castle, till I am two thirds over; then steer directly for Hurst Castle, and when abreast of it, borrow pretty near it, and then steer right for the Needles Point: great Regard must be had to the Tides, for the Flood sets on the Needles, and the Ebb on the Shingles.

N. B. It flows at St. Helen's nine Hours at the Full and Change, and when it is half Water, you have a Tide to work it with; there is a Shoal, called the West Middle, about two Miles W. by N. half N. from Ride Middle; it lies S. E. and N. W. about a Mile and a half in Length, and has but twelve Feet at Low-water: when you are abreast of the N. W. Part of it, Calshot Castle is N. N. W. half W. South-sea Castle will then carry you clear of it, if you keep it a Sail's Breadth to the Southward of the Gilkicker Point. The Brambles is a Shoal that lies N. N. W. from the West Middle, Part of it is dry at Low-water. If you fail to the N. W. of the West Middle,

Middle, you sail between it and the Brambles, leaving the Brambles on the Starboard Side. When you come to the West of Cowes-Castle, you must give it a good Birth, by Reason of a Ledge of Rocks that lie off from it. There is Warding's Rock that lies on the Island Side; to keep clear of which, you must keep the Vanes of the Windmill that is on the Isle of Wight in Sight; and that will carry you clear. When you come near the Needles, give them a good Birth to avoid the Chalk Rock: You will have in the Fair-way nine or ten Fathoms; but when you come to the Chalk Rock you will have but four Fathoms.

Q. If you are bound or forced into Portland, what Precautions are necessary?

A. I must take Care of the Shambles; they lie about E. by S. or E. S. E. three Miles from the Bill of Portland, and have but 14 or 15 Feet on them at low Water. To go into the Road, I must keep Weymouth Castle open with the Eastermost Part of Portland, or open with the Stone-pier, and run until I bring the Eastermost Part of Portland S. by E. or S. S. E. in 8 or 9 Fathoms; keep Week Church open, and that will carry you clear. It flows from the Road to the Bill E. S. E. $7\frac{1}{2}$ Hours. The Light-houses bear from each other N. and S. the Flood sets right off the Bill 9 Hours.

N. B. In case you should be embayed to the Westward of Portland, and no Possibility of getting out, between Burton and Chisell, where it ebbs 9 Hours, and flows only 3, there is a steep Beach of Pebbles, there run your Ship on Shore with as much Sail as you can carry, especially at the beginning of an Ebb, and remain on board for three or four Seas, and you may get on Shore safely.

Q. How would you anchor in Torbay?

A. Bring the Bury-head to S. by E. or S. S. E. and let go my Anchor in 8 or 9 Fathoms Water.

Q. What is to be observed in sailing into Plymouth Sound?

A. If coming from the Westward, and am got round the Ram-head, I must give Penlee Point a good Birth, by Reason of a Ledge of Rocks that lies off from it; then haul N. N. E. $\frac{1}{2}$ E. For anchoring, the best Mark is Mount Edgumbe just open, the Withy Hedge right up and down, and St. Nicholas's Island N. W. the leading Mark is Plymouth Church open with the West Part of the Citadel. The Dangers going in are, the Swift-sure N. by W. one Mile and a half, and about half a Mile E. Southerly from that is the Shag-stone; there is a Buoy on each of them, and but 17 Feet at low Water; must leave them on the Starboard Side.

Q. What are the Dangers sailing into Falmouth Harbour, and the best Way to avoid them?

A. The Dangers are the Manacles and the Falmouth Rock. The Manacles lie S. and S. by W. from Falmouth Harbour; and the Rock is known by a Pole standing on it, and lies nearest the West Shore. The best going in is on the East Side of the Rock; it is a

narrow, deep Channel, which I may fail up by the Lead, and borrow to St. Mawe's Side to 5 or 6 Fathoms Water; the East Side is the shortest. The best Anchoring is in Carrick Road, St. Mawe's Castle bearing E. S. E. laying my Eastermost Anchor in 18 Fathoms, and my Westermost in 6 or 7 Fathoms.

Q. What are the Dangers that lie off the Lizard and the Land's End?

A. Many. 1st. The Rundlestone is a Rock that lies almost to the South Eastward of the Land's End, Distance about 4 Miles; to avoid it, I must keep the Tower of the Church that stands on the Land's End open, and that will carry me clear of it; but if I keep so near the Land as to hide the Church, then I go between the Land and the Rock; and when I am a-breast of the Red Cliffs that are by the Water Side, then I am a-breast of the Rock. 2dly, The Vaule is a Rock that lies about S. S. W. of the Land's End, Distance 3 Leagues, and makes like the Bottom of a Ship at half Tide. There are 43 Fathoms Water close to it on either Side. 3dly, The Gulph or Wolf Rock lies from the Lizard about West, Distance 10 Leagues, and from the Land's End S. S. W. Distance 4 Leagues; it is peaked, and appears above Water at half Tide; round about it is a clear Ground. 4thly, Breson lies from the Land's End about N. or N. by W. distance 5 Leagues. 5thly, The Seven Stones are a Row of Rocks that come not above Water, but the Sea always breaks over them: They lie from the Land's End W. $\frac{1}{2}$ S. Distance 7 Leagues, and from St. Martin's Head, Scilly, N. E. Distance 3 Leagues.

Q. How does the Land's End appear when you first make it?

A. It appears Hummocks, with a Church on it; and may be seen in 54 Fathoms Water 8 or 9 Leagues off.

Q. How do you know the Lizard when you first make it?

A. It is the Southermost Land on the Coast, and may be seen 7 or 8 Leagues off, in 42 Fathoms Water.

Q. If you were forced into Mount's Bay, where would be the safest anchoring Ground?

A. Mount's Bay lies between the Lizard and the Land's End; on the East Side of it is a high Island, and on the West a Castle, called St. Michael's Mount. From the Eastward of the Bay lies a Ledge of Rocks near a League into the Sea; the Coast is full of Rocks, and not safe to anchor in. To sail into this Place I must bring St. Paul's Steeple W. N. W. keep over to the West Shore, and make St. Clement's Island, which is before the Town of Mouseholes, having the Castle on the Starboard Side: I shall then see a large Sandy Bay; and, when within the Island, there is good anchoring in 7 or 8 Fathoms Water, Land-locked from all Winds but a S. E. Wind.

Q. What are the Dangers going into Scilly, and the best Marks to avoid them?

A. St. Mary's Sound is the best Way into Scilly. St. Mary's Island lies on the S. E. Side, and hath a Garrison thereon, and a Wind-
mill

mill a-breast of it. The Dangers are, 1st, The Spanish Lodge, which I must leave on the Larboard Side, near Smith's Island; it shews itself in bad Weather; and the next is Norman's Rock, on the Starboard Side, above a Cable's Length from the first. From St. Mary's Island, a little without the Eastermost Point, the Mark to lead me is to keep the Vanes of the Windmill upon a Line with the two Rocks that lie on the West Side, so that I may go between them into the Fair-way.

Direction for Working a Ship in all difficult Cases that probably may happen at Sea.

Q. Suppose your Ship is lying at Spithead; and the Wind at N. E. at what Time of the Tide would you unmoor?

A. As soon as she tends to the Ebb, I would veer away upon my small Bower, and take up my best Bower.

Q. How do you unmoor?

A. I would turn all Hands up, see all clear below, rig the Davit *, overhaul the Catt and Fish, ship the Bars and Pins; then send some Hands down to the Cable, clap the Stoppers on the best Bower before I unbit it; then rouse down the Slack, bring to the Vial, and heave taught; then clap the Stoppers on the small Bower before the Bits, and unbit. If there is a fresh Breeze, I'll veer with it bited; then heave on the best Bower till it is above the Surface of the Water, then pall; out Bars, hook the Cat; haul it taught, and surge the Vial, then stick out the Cable below; belay the Cat; pass the Stoppers, and haul the Fish by Hand; then hook and bounce to the Stock, belay the Fish, haul in the Buoy and Rope, and pass my Shank Painters; then slack the Cat and Fish, unhook the Anchor, and see all clear for letting it go again. I would likewise bit the best bower with a Range, rig the Davit out on the other side for the small Bower, lift the Capstain, shift the Vial, and proceed as before. If it does not blow hard, I would loose the Top-sails, and when the Anchor's a-peak, or when I think myself near enough without tripping it, I would haul home my Top-sail-sheets and hoist them.

Q. How do you cast a Ship?

A. If I am to cast the Ship to Starboard, would haul my Larboard Braces forward, and let my After-yards lie square: I may hoist the Fore-top-mast-stay-sail, and keep the Sheet to windward to help her. If I am to cast her to Port, I would haul in the contrary Braces; when cast, fill the Head-sails, and brace up as Circumstances require.

N. B. If the Ship is Wind-ode, as soon as the Anchor is right up and down, put the Helm the Way you would have her cast, setting in the same Braces abaft, and the contrary forward; but if she is Tide-ode, put your Helm the contrary Way to which you would have her

* NOTE. I have given this in the Terms commonly used at Sea; an Explanation of which is given further on.

cast, and set in your Braces forward. Which ever Way your Helm is, your Braces abaft must be the contrary.

Q. How would you tack a Ship with all her Sails set?

A. I would hand down the Lee-bow-lines, stretch along the Weather-braces, haul taught the Weather-sheet and Lee-tacks; then put the Helm to Lee; let go the Fore-sheet and Fore-top-bow-line, Jibb, and Stay-sail-sheets: When the Fore-top-sail touches, brace to and help her. When aback, brace and help her. When the Wind is out of the After-sails, raise the Tacks and Sheets, shift the Stay-sail-tacks, and haul over the Stay-sail-sheets. When the Wind is a-head, haul the Main-sail. If she has Stern-way, shift the Helm, square the Sprit-sail-yard, haul on board the Main-tack, and aft the Main-sheet; brace up the Main-yard; when the After-sails are full, let go and haul: Haul on board the Fore-tack, keep in the Weather-braces forward, and let her come to; then brace up, haul aft the Fore-sheet, Jibb, and Steering-sails, set the Back-stays up, and haul the Bow-lines; then haul taught the Weather-braces, Lee-tacks, and Weather-sheet.—Note: Should the Wind take me a-head, I may haul the After-sails about, shift the Mizzen-sheet and Stay-sail-tacks, and then work the Ship the same Way as in Tacking.

Q. How would you tack a Ship under her three Top-sails?

A. I would put the Helm to Lee, keep fast the Fore-top-bow-line; when the Fore-top-sail touches, brace to and help her; when the Wind is a-head, haul the Main-top-sail, and shift the Helm; then brace up the Main-yard, and haul the Main-top-bow-line. When the After-sails are full, let go and haul: Keep in the Weather-braces forward, and when she comes to, brace up and haul the Main-top-bow line and Weather-braces.

Q. How would you veer a Ship with all her Sails set?

A. I would haul the Mizzen up, and the Mizzen-stay-sails down, hard a Weather the Helm, shiver the Mizzen-top-sail, let go the Main, and Main-top-bow-lines, ease off the Main-sheet, the Lee-main-brace, and round in the Weather braces. When the Wind is abaft the Beam, ease the Main-tack; when the Wind is aft, square the Head-sails, and get the Tacks on board; get aft the Sheets, shift the Jibb and Stay-sail sheets over the Stays, and as she comes to, haul the Mizzen out, and haul aft the Mizzen-stay-sail sheet, brace the Head-yards up, haul the Bow-lines, and trim all sharp. If a fresh Wind, it is proper to shorten Sail; in Top gallant-sails, down Jibb and Steering-sails, take two Rcefs in the Top-sails. If it continues to blow harder, in Top-sails; I would take in the Fore-top-sail first, because it will ease the Ship forward; for when it blows hard we generally have a Head-sea, and she keeps to the better. Let go the Fore-top-bow-line, lower away the Haul-yards, ease away the Lifts, haul in the Weather-braces when the Yard is down, ease away the Lee-sheet, and haul the Clue-line and Bunt-line close up; then start the

the Weather-Sheet, and clue it close up, lye-to, and furl the sail : Then take in the Main-top-sail, and the Ship is under her Courses.

Q. How would you veer a Ship under her Courses ?

A. Haul up the Mizzen, and down the Mizzen-stay-sail, put the Helm a-weather, ease off the Main-sheet, (or, if it blows hard, hand it) let go the Lee-main-braces and Bow-lines, as she falls off gather in the Weather-braces. When the Wind is abaft the Beam, raise the Main-Tack ; and when the Wind is almost right aft, haul aft the Main-sheet, and brace up the Yard ; and when she is before the Wind, square the Head-sails, haul over the Fore-top-sail-sheet, get aboard the Fore-tack, shift the Helm, gather aft the Fore-sheet, as she comes to, haul the Mizzen out to ease her, trim all sharp, haul the Bowlines.

Q. How would you veer a Ship under a Main-sail, the Fore-stay-sail being blown away ?

A. To lay to upon the other Tack I must watch the Ship's falling off, put the Helm a-weather, and as she falls off ease off the Sheet ; but if that will not do, I would get some Hands up in the Fore shrouds with Tarpaulins ; if she will not veer with this Method, I would haul aft the Main-sheet again, and lay her to as before, and then get a Piece of Canvas, and lash it round the Lee-quarter of the Sprit sail-yard, and top the Yard up as much as possible to prevent the Sail from filling with Water when it is loosed. When the Ship falls off, put the Helm a weather, cast loose the Lee-yard-arm of the Sail, and haul aft the Sheet, and as the Ship falls off, ease off the Main-sheet, and gather aft the Weather-brace ; raise the Tack, and gather aft the Sheet, and when the Ship is before the Wind, get on board the other Tack, aft the Sheet, square the Sprit-sail-yard, furl the Sail, ease down the Helm, haul close aft the Main-sheet, brace up sharp, and haul the Bow-line.

Q. Suppose she will not veer for all this ?

A. Then I would loose the Goose-wings of the Foresail ; if that will not do, set the Foresail, and veer her as under Courses, or haul the Main-sail up ; if by hauling the Main-sail up and handing it she will not wear, strike the Mizzen-yard lower-down, strike the Cross-jack-yard and Mizzen-top-mast ; and if that will not do, cut away the Mizzen-mast.

Q. How would you proceed if a Top-sail splits ?

A. Let go the Bow-lines, and lower away the Haul-yards, clue up the Lee-sheet, and haul up the Bunt-lines, start the Weather-sheet, haul in the Weather-brace, belay the Clue line, Bunt-line, and Brace, unbend the Sail, and bend another, then either furl or set it as Circumstances require.

Q. Suppose it blows hard and you split your Main sail, what would you do ?

A. I would haul it up, and settle the Yard ; unbend the Sail, and bend another ; get aboard the Main-tack, and aft the Sheet, and then sway the Yard up. The Sail being a-back will prevent its fluttering. Let the Sail fill, which will help and make the Yard go up the easier ;

easier; while I am doing this the Mizzen-stay-sail should be set. When the Sail is full, and the Wind blows hard, get a Tackle on the Weather-leach to secure the Tack, and Preventer-sheets; but in small Ships they get the Lee-tacks for Preventer-sheets.

Q. How do you reef the Top-sails?

A. I would let go the Bow-lines and Lee-brace, lower the Haul-yards, haul down upon the Clue-lines, and in the Weather-braces, clear away the Lift, and Reef-tackles; when the Yards are down by the Lifts, haul out the Reef-tackles according to the Number of Reefs I am going to take in; haul in the Weather-braces so as to have the Wind out of the Sail; then haul taught the Lee-braces for the first Reef, clue the Sails well up before the Yards, and have the Points well abaft the Yards and in second Reefs; and if for the third Reefs, keep the first and second Reefs well up before the Yard, and haul the Points of the third Reef aft; I must haul the Weather-earing out first, and mind to take the Turns clear, and not to jamb them in taking the third Reef. If it blows hard it is best to clue the Top-sail up.

Q. How would you box a Ship off?

A. Put the Helm to Weather, haul up the Mizzen, and down the Mizzen-stay-sail, raise the Fore-tack, let go the Fore and Fore-top-bow-lines and Fore-sheet, round in the Weather-braces forward, haul the Jibb and Stay-sail-sheets in flat forward, and up the Lee bow-lines: If she has Stern-way, put the Helm to Lee: When she pays off, and the After-sails are all full, ease off the Jibb and Stay-sail-sheets; brace about the Head-sails, and bring on board the Fore-tack; but if she has Head-way, right the Helm, and tend her coming to; then brace up sharp, haul the Bow-lines.

Q. Suppose you are on a Wind, close upon the Land, and standing on must run on Shore, and you can clear the Land on the other Tack; but it blows hard, and a Head-swell that she won't stay, and should you veer you would be on Shore, how will you get upon the other Tack?

A. Some would say I should club-haul her. This is done by putting the Helm to Lee, and letting go the Lee-anchor, and bring her up, Head to Wind, cut the Cable, and haul about the After-sails; and when they are full, brace about the Head-sails, haul on board the Fore-tack, and brace up the other Way; but that which is most common is, by Box-hauling her.

Q. How would you Box-haul a Ship?

A. If she refused Stays, I would haul the Mizzen up, haul about the After-sails, and let go the Weather-bow-lines forward; haul the Lee-bow-lines, set in the Weather-braces, and keep the Head-sails a-back to prevent the Ship's having Head-way, by which means she will pay round in her Length. I must observe to keep the Helm a-lee, by Reason she will have Stern-way, and as she falls off, must keep the After-sails shivering; when she is before the Wind, brace
up

up abaft, and get aboard the Fore-tack, and as ſhe comes to, haul the Mizen out, and trim ſharp.

Q. Suppose you are upon a Wind, and let the Ship come up in the Wind, and are all a-back, what would you do?

A. Haul the Mizen up, let go the Main and Main-top-bow-lines, the Lee-main and Main-top-fail-braces, and lay all ſquare abaft; put the Helm to Weather if ſhe has Stern-way; when the Wind is abaft, ſhift the Helm; and as ſhe gets Head-way, haul in a little of the Starboard Braces abaft, haul the Mizen out, and brace ſharp up abaft, and haul the Bow-lines, and then I am on the ſame Tack as before.

Q. If by Accident your Ship were brought by the Lee, what would you do?

A. When a Ship is brought by the Lee, it is commonly occaſioned by a large Sea, and by the Neglect of the Helm's-man. When the Wind is two or three Points on the Quarter, the Ship taking a Lurch, brings the Wind on the other Side, and lays the Sails all dead to the Maſt; as the Yards are braced up, ſhe then having no Way, and the Helm being of no Service, I would therefore brace about the Head-fails ſharp the other Way, then haul the Main-fail up, and juſt keep the Main and Main-top-fail ſhivering: When ſhe gathers Way, and brings the Wind aft again, raiſe the Fore-tack, and ſquare the Head-fails; trim the Sails as they were before, and bring her to her Courſe again handſomely.—N. B. It is dangerous to bring a Ship by the Lee in a Gale of Wind; for ſhe lying entirely againſt the Sea, her Sails can be of no Service till braced about.

Q. Suppose you were upon a Lee ſhore, and had neither Room to veer or ſtay, nor any anchoring Ground, how would you put the Ship's Head round the other Way?

A. I would put my Helm hard to Lee, and when ſhe comes Head to Wind, raiſe the Main and Fore-tacks directly, make a Run with my Weather-braces, and clap all back at once; then haul forward the Lee-tacks and Bow-lines as far as I can, that the Ship may fall round on her Heel; and when the Main-fail begins to ſhiver, I would haul it up, and fill my Head-fails, and ſhift the Helm hard a-weather; then when the Wind comes on the other Quarter, haul on board the Main-tack, and bring her cloſe to the Wind.

Q. Suppose you were upon a Lee ſhore, and had neither Room to wear or ſtay, and you had anchoring Ground, what would you do?

A. When I ſee the Danger, I would take a good Hawſer and lead it out of one of the Quarter-ports, and bend it to the Anchor to Lee-ward; the other Part I would bring to the Capſtan, and ſhip the Bars, and when I go to tack, clap my Helm a-lee: As ſoon as the Wind is out of the Main-fail haul it up, and then let go the Anchor, and heave on the Spring to caſt her; becauſe the Cable ſhould not check her when ſhe comes Head to Wind: Brace about the Main-yard

yard, haul on board the Tack, and cut away the Cable and Spring; when the Main-sail fills, set the Fore-sail; haul aboard the Tack, and trim her to the Wind.

Q. Suppose it blows hard, and you cannot carry your Courses, Night coming on, and it is likely to blow harder, what will you do?

A. I would haul the Fore-sail up and furl it, balance the Mizzen and reef the Main-sail, haul the Mizzen out to keep her to, then haul up the Main-clue-garnet and Bunt-line, square the Yard, and get Stops round the Mast by the Booms to hook the Yard-tackles to for Rolling-tackles; then lower down the Yard, and reef the Sail; haul on board the Tack, get ast the Sheet handsomely, and sway the Yard up. Tend the Braces, bounce up the Bow-line, and haul up the Mizzen.

Q. You are just a breast of Portland, the Wind has taken you a-back, and you have not Time to take in your Sails, for you will be on Shore presently; how will you proceed?

A. If she has Head-way I will put the Helm a-weather, let go the Fore-sheet and Larboard-braces; as soon as the After sails shiver, haul down the Main-top-mast-steering-fails, and if it blows fresh take in Top-gallant-fails. Brace up the After-yards; when full, brace up forward, and haul on board the Fore-tack, and trim all sharp; haul taught the Weather-braces, and haul the Bow-lines.

Q. Suppose the Ship is under Top-fails, and you must make all the sail you can?

A. Down Fore-sail, hoist Jibb and Stay-fails, set Top-gallant sails and Royals fore and aft, set Sprit-sail, and Sprit-sail-top-sail and Driver; haul taught the Lee-clew-lines and Weather-lifts and Braces; then rig out the Top-mast-steering-booms, and send down the Haul-yards and Tacks; then hoist up the Top-mast-steering-fails and Top-gallant-steering-fails, and then set the lower Steering-sail forward.

Q. In case you were to carry away your Mast, what Method would you take to get clear of the Wreck?

A. I would put my Helm a-weather to give the Ship some Way through the Water, and then cut away.

Q. Suppose you were to carry away your Bow-sprit, what would you do?

A. Should that happen, or that I should spring my Bow-sprit, I would immediately wear Ship, and keep her before the Wind; and then, for Security of the Foremast, I would carry forward Runners and Tackles, and bounce them well taught, till I can get a Hawser, or sufficient Rope, and clench it round the Mast-head, and secure it to the Bitts of the Fore-castle, or to the Cat-heads.

Q. Suppose the Wind at S. W. and you are well up the Channel, making the best of your Way to the Downs, how will you proceed if it blows hard, and you are under a Main-sail?

A. Reef

A. Reef the Fore-sail, and then haul the Main-sail up, and veer Ship, then furl it; when before the Wind, set the Fore-sail; when a-breast the Fore-land, haul the Fore-sail up and furl it, and run in under bare Poles. Hook the Top-tackle-falls; see the Lee-jeers, Top-sail-sheets, Lifts, and all clear for striking Yards and Top-masts. Then run into a good Birth, and strike Yards and Top-masts: The Sheet-anchor being over the Side, and the best Bower bitted with a long Range, the Stoppers, Ring-ropes, and Stream-buoy all ready, put the Helm to Port, haul the Mizzen out, and let go the best Bower, and veer away two Cables before I check her; then veer away half a Cable more, and bring her up. When the Ebb makes, I would let go the small Bower in nine Fathoms Water, having Deal-Mill and Deal-Castle in one.

2. How do you clear a Ship for Action?

A. Turn all Hands up to clear Ship; up all Hammocks, and call the Quarter-masters to flow them in the Netting and Gunwale, in the Waste, and on the Fore-castle; get the Hammocks in the Tops, they that are quartered there; down all Chests into the Hold, take in all small Sails, sling the lower Yards and Top-sail-yards, get the Puddings and Dolphins about the Masts, stopper the Top-sail-sheets, rack the Main and Fore-jeers, and get the Preventer-braces secured in their Places; cause the Gunners to see the Match-tubs ready; haul the Courfes up, keep Silence, and avoid Confusion.

Necessary Remarks on coming into the Channel.

PERSONS coming from a long Voyage, without Doubt, try for Ground in Time, and, if possible, would keep in the Latitude of 49° N. in which Latitude, and in ninety Fathoms Water, you will have fine Sand sixty-six Leagues from the Lizard; but, should you be in the Latitude of Scilly, then coarse Ground, and eighty Fathoms. In coming in, having struck Ground in ninety Fathoms, you will, from the Latitude $49^{\circ} 30'$ to 49° , meet with the same Depth; then, failing six or seven Leagues, you will shoal five Fathoms at once; you run in that Depth for some Time, and deepen again; and perhaps in three Leagues you shoal again; for it is to be supposed the Ground is not gradual: You must therefore have Recourse to the general Soundings, not to Particulars. But if, in coming in, you meet with Sand interspersed with black Specks like beaten Pepper, and you have sixty-four Fathoms, then Scilly bears N. E. by N. fourteen Leagues; and if, at any other Depth, you have the same Soundings from ninety to sixty-four Fathoms, you have the Channel fairly open. When you are in the Latitude of $49^{\circ} 30'$, and have seventy-five Fathoms, you must be sure to steer E. by S. or E. S. E. and then you will but keep your Latitude good; which, if possible,

do not go to the Northward of, till you get within Scilly; nor then, without you have an Opportunity of making the Land. When you are a-breast of Scilly, if you be not to the Southward of $49^{\circ} 25'$, nor to the Northward of $49^{\circ} 20'$, and have sixty Fathoms, you are sure to be the Length of Scilly, and in the Latitude as before mentioned; with thirty-five Fathoms you are a-breast of the Lizard.

If at any Time you should be to the Southward, and have from ninety to seventy Fathoms, or in the Latitude of Ushant, or farther Southerly, you will have reddish Gravel Sand, with many Pieces of Shells; which Soundings are no where to be found in the Channel. If in the Latitude of Ushant you have eighty-six Fathoms, you are distant from thence thirty-six Leagues; if seventy Fathoms, eleven Leagues; then you must be careful in the Night or thick Weather to come no nearer to it than sixty-three Fathoms, nor to the Leams than sixty-five Fathoms. You may know when you are to the Northward or to the Southward of Scilly by the Ground. When you are to the Northward, or in the Latitude of it, you have Ouze on the Lead from eighty-five to sixty Fathoms; then you must haul to the Southward till you meet with coarser Ground, which you will have to the Southward of Scilly; you may depend on having Ouze on the Lead in this Latitude, or to the Northward of it; so that, if you keep the Lead going, you may prevent falling to the Northward. For your better knowing when you are near Scilly, you will find on the Lead black Stones, the like of which are nowhere else in the Channel. In the Night come no nearer than fifty-three Fathoms; and in that Depth you are not above three Leagues from the Scilly Rocks. That you may know if you be within Scilly, and in the Channel, stand to the Southward, and you will have deeper Water; to the Northward, and you will have shoaler. Come no nearer to the Lizard, in the Night, than forty-five Fathoms. If running up the Channel in the Night, keep without the stream of forty Fathoms, for in that Stream the Eddystone lies: Between the Start and Portland, no nearer than twenty-four Fathoms; nor from Portland to the Nefs, than twenty Fathoms, if in the Night or thick Weather. When you are in the Fair-way, up Channel, you will always have fine Sand, intermixed with black Specks and Hake's Teeth. By this Time you will most probably have made the Land; but observe, that between Beachy and the Wight there are from thirty to thirty-eight Fathoms Water; by which you may be led to imagine yourself farther out than you are. That Depth is found at four Leagues Distance from the Oars and Eastborough-head.

N.B. The foregoing Remarks, and the Method of working a Ship, are the best I could collect from Mariners, who very often differ in their Methods, and therefore may be disputed; particularly in that of Box-hauling a Ship. As this is not my Province, it is hoped every judicious Mariner will excuse any Errors committed in a Thing which is calculated merely for the initiating of young Practitioners.

The Manner of Surveying Sea Coasts and Harbours.

IT is a general Complaint among Seamen, that few Sea Charts are found correct; and this perhaps may be owing to the Manner of surveying the several Coasts, and copying from old Sea Charts; but as the Longitude of Places can now be better ascertained than formerly, it is hoped more accurate Maps will be made, as they are so very essential to the Mariner; who may, from the following Hints, either correct the Charts that are extant, or make new ones of his own, of those Parts he may have occasion to fail by or touch at.

From what has been already said in Oblique Sailing, an intelligent Reader may see how the Business of taking the Bearing of Part of a Coast, and of plotting or delineating it might be done; but as there are some Particulars which can be gained only by Experience in the Art of Surveying, it will not be improper to apprize the Learner of them, and thereby qualify him to go more readily to work.

To take the Draught of a Coast in sailing along it.

1st. Having brought the Ship to a convenient Place, from whence the principal Points of the Coast or Bay may be seen, either cast Anchor if it is convenient, or lye-to as steady as possible; or if the Coast is too shoal, let the Observations and Measures be done in a Boat: Then while the Vessel is in a stationary Situation, take, with the Azimuth Compass, the Bearings, in Degrees, of such Points of the Coast as form the most material Projections or Hollows; write down these Bearings, and make a rough Sketch of the Coasts, observing carefully to mark the Points whose Bearings were taken with Letters for the sake of Reference.

Then let the Ship or Boat run in a direct Line, which must be very carefully measured by the Log or otherwise, one, two, or three Miles, more or less, until she comes into a Situation from whence the same Points before observed can be seen again; there let the Vessel lye steady as at the foregoing Station; and again, observe the respective Bearings in Degrees of the same noted Points, which are also to be wrote down, and a rough Sketch of the Coast should also be taken from this Station; for which Purpose prepare an Observation Table, in which write distinctly and regularly the several celestial Observations, Bearing, Distance measured by the Log-line; Rocks, Shoals, Soundings, Overfalls, Races of Tides, and other Remarks that may be made along the Coast. The Table may consist of seven or eight Columns, disposed in the following Order.

Observations in Navigating the Coast of —, from Cape — to Point —, being — Miles, measured by the Log, the Course from Station I. to II. being S. $\frac{1}{4}$ W.

Year, Month, and Day	Meridian Altitude of Sun.	Bearings at Station I.	Time and Distance sailed from Station I.	Bearings and Distances taken at these Distances.	Bearing of Rocks, Shoals, and their estimated Distances when on a Line with the Points or Heads of the Coast.	Remarks on the Tides and the Nature and Dimensions of Rocks, Shoals, and Anchorage.
	D. M.	/	H. M. Mi.	Fath.	Points and Heads.	M.
1775 June 21st.		A. W. 27° N. a. W. 14 S.	1 27 $\frac{3}{4}$ 11 45 5	A. N. 5° W. b. W. 20 S. 22	C. and Rock W. 9° N. 5; J. and Hill S. 19° W.	This Rock is dry at low Water, and seemed 100 Yards in Length from N. W. to S W. a leading Mark to it is, —

While the Vessel is running the Base Line from Station to Station, more accurate Appearance of the Coast should be made. To do which, let four expert Persons be appointed; one to take the Bearing exactly with the Azimuth Compass; one to oversee the running out of the Log-line, and to keep an Account of the Ship's Way, so as to be readily able to tell the Distance run when required; the third to attend the heaving of the Lead, to write down the Soundings and Bearings of one or two Head Points or remarkable Parts of the Coast taken at each Depth; the fourth a Draughtsman, to draw out the necessary Bearings and Distances, and delineate the Figure and Windings of the Coast at each Station, and to

correct

correct their Forms and Dimensions while the Ship is sailing along the Land. Then let the several Bearings be corrected by the Variation to reduce them to their true Positions. Then,

In some convenient Part of a Sheet of Paper describe a Circle, the larger the better, on which lay off the several Bearings taken from the first Station, and let them be numbered 1, 2, 3, &c. on the Outside of the Circle: Also lay down the several Bearings taken at the second Station; let these be numbered 1, 2, 3, &c. on the Inside of the Circle, observing that the Bearings of the same Points are numbered with the same Figures.

Draw a Line to express the Ship's Run both in Length and Course; and from that End of the Line expressing the first Station draw Lines parallel to the respective Bearings taken from that End, and marked on the Outside of the Circle. Also from the other End draw Lines parallel to the Bearing taken at that End, and note it on the Inside of the Circle; mark the Intersection of each Pair of Lines, directed to the same Point with the Number annexed to their Bearing; and through the Intersection so marked draw by Hand a curved Line, observing to wave the Line in and out, as near as can be like the bending of the Coast itself.

Against each Part draw the Appearance of the elevated or low Ground in the Sketches, distinguishing Rocks, Cliffs, High Land, Low Land, Sand Hills, &c. If there are any Currents or Eddies, express them in their proper Places by Darts or Arrows, the Points being turned that Way the Current sets. Put in the several Soundings at Low-water in small Figures, distinguishing whether Fathoms or Feet; shew the Time of High-water, on the Full and Change Days, by Roman Figures, and tell the Rise in Feet: Put in a Compass, with a Scale of Miles or Leagues, such as the Vessel's Run was laid down by; add the Name of the Place, the Coast, and the Latitude and Longitude, as true as can be obtained.

If there is a Shoal, or Sands on the Coast, let it be taken by a Boat sailing round it, and keeping an Account of the Courses, Distances, and Soundings; but to put in the Draught, the Boat must, from some Part of the Sand or Shoal, take the Bearings of two Points on the Coast, whose Bearings have been taken from the Ship: Or the Bearing of the Boat at some Part of the Shoal, or of some Beacon in that Place, must be taken by the Ship, at the Stations where she takes the Bearings of the Shore; for by either of these Means, one Point of the Sand being obtained, the rest of it can be laid down from the Boats Account.

If the Coast to be drawn is a Bay or Harbour, winding in such a Manner that all its principal Points cannot be seen at two Stations, let as many Bases or Lines be run, and exactly measured, as may be found necessary; observing that the several Distances run should join to one another in the Nature of Traverse; that each new set of Objects or Points observed should be taken from two Stations at the

End

End of a known Distance ; and that the Objects, whose Bearings are taken, do not extend so much beyond the Limits of the Base, as to make Angles with it of less than about $\frac{1}{2}$ or $\frac{1}{4}$ of a Point, but rather reserve such Objects for the next measured Base ; for when Lines lye very oblique to one another, their Intersections is not easily ascertained.

If any particular Parts of the Harbour cannot be conveniently seen from either of the Stations, take the Boat into those Places, and having well examined them, make Sketches thereof, estimating the Length and Breadth of the several Inlets, either by the rowing or sailing of the Boat, taking as many Bearings, Soundings, and other Notes as may be thought necessary ; then annex these particular Views in their proper Places in the general Draft.

If there are any dangerous Sands or Rocks, besides inserting them in their proper Places, there should be a double Line drawn through that Point and one or more Objects ashore ; and for this Purpose chuse a Church, Mill, House, noted Tree, a Clift, or any remarkable Thing that can be distinctly seen at Sea, and which can be brought to bear in the same right Line with the Point to be avoided ; but if that Point is under Water, there must be two Land Marks brought to bear with the Danger, either in a right Line, when it can be, or in two Lines ; and that those two Lines, and that those Land Marks may be put down in their proper Places, their Bearings must also be taken from two of the Ship's Stations.

It should be remarked in the Draught what Places, if any, are unfit for Anchorage, and what are fit, by writing *rocky Ground, foul Anchorage, good Anchorage* ; and in the latter to draw the Figure of an Anchor. Also, if there is any particular Channel more convenient to sail through than another, it is to be pointed out by Lines drawn to its Entrance from two or more noted marks ashore.

The foregoing Method of surveying a Coast, supposes in general that it is taken by a Ship in her Passages along, not having an Opportunity of going ashore. But when the Circumstances will permit the Measures and Observations to be made on Land, the Survey can be taken more accurately than on the Water.

To Survey a Harbour by Observations on Shore.

Make an Eye-draught of the Place to be surveyed ; and in going round its Coast, fix in the most remarkable Points and Bends of the Shore Station Staves, or streight Poles, tall enough to be seen at a considerable Distance : But if at any of those Places there is a noted Tree, House, or any other remarkable Thing, that Object may serve instead of a Station Staff ; and it will be convenient to black the Staves, and tie a Piece of white Bunting to the Top of each : Then in the Eye-draught put Letters at the noted Points, or Marks, for Distinction sake.

Chuse

Chuse the most level Spot of Ground, wherein a base Line may be measured, of one or more half Miles in Length, or a Length of not less than a tenth Part of the Distance of the two extreme Objects marked for observing, and let the Direction of the measured Base Line be so laid out, that from both Ends of it as many as possible of the Station Staves before planted, or the Objects before remarked, may be seen. The Bearing or Position of this Base must be well determined in Degrees and Minutes; and also its Length must be accurately measured to Feet and Parts, either by a measuring Chain, or by a Piece of Log-line of 100 Feet long, properly marked at the End of every 10 Feet, and each End Length marked at every Foot.

From one End of the Base observe (with any Instrument proper to take Bearings) the Position or Bearings, in Degrees and Minutes of all the Staves or Object within Views, and write them down orderly; do the same from the other End of the Base, and let all the Bearings be corrected by the Variation of the Compass.

Then, these Measures and corrected Bearings, being plotted or laid down, will give the most conspicuous Points of the Shore, the intermediate Spaces are to be filled up from the Sketches of them made on the Spot.

But if any of these Objects should spread on either Hand so far beyond the Limits of the Base, that at either End thereof the other End, and those Objects or Staves should appear nearly in the same Direction, or to make Angles not exceeding about 10 Degrees: Or, if some of the remarked Objects can be seen from only one End of the Base, then let the Bearings of such Objects be taken from a Place whose Position has been determined from both Ends of the measured Base; or if there are several remarked Objects, which cannot be seen from neither End of the Base Lines, let the Bearings of such Objects be taken from each of two Points, whose Position have been taken from both Ends of the Base. Or it may on some Occasion be proper to chuse another Place, on which another Base of a convenient Length may be measured, and from the Extremities of which the Ends of the first Base may be seen; and also as many as can be of the remaining Objects which lay too oblique for the first Base, or which could not be seen from it. In such Manner proceed, until the Bearings are taken of all the Points judged necessary for completing the Survey of the Limits of the Harbour.

If a Base of a sufficient Length cannot be measured in one right Line, it may be taken in two adjoining Lines as the two Sides of a Triangle; the included Angle being accurately taken, and the Bearing of either Line.

When the Outlines or Limits of an Harbour, Bay, Road, &c. are delineated by the preceding Precepts; the Appearances of the Shores, with the adjacent remarkable Objects correctly drawn; a Compass, with the Variation and Scale properly fitted to the Plan; the

the Isles, Rocks, Sands, &c. marked in their proper Places; the Setting and Drift of the Currents and Tides; the Times of High-water on the Days of Full and New Moon, with the Rise of Water at those Times, and whether whole Tide, or Tide and Part; the best anchoring Places with their Soundings at Low-water, and the Winds open to them; the best Track, with the Soundings all the Way to those anchoring Places; the proper sailing Marks to avoid Dangers; the Winds, if any troublesome ones, which prevail, and at what Seasons; the Places where fresh Water can be got; the Name of the Place, the Country in; on what Sea, the Latitude and Longitude; a Sketch of the Appearance the Place makes at Sea upon a known Rhumb, and at an estimated Distance; and whatever else a judicious Seaman shall think proper to insert; then is the Plan fit for all nautical Purposes, and may be embellished with proper Colours if necessary.

Sea Draughts taken according to the foregoing Precepts, and neatly drawn and coloured, besides the real Use they may be of, cannot fail to recommend the young Mariner, who surveys and constructs them, to the Notice of his Superiors.

To reduce a Draught to a larger or smaller Scale.

With a Black-lead Pencil draw the Draught to be reduced all over with cross Lines, forming exact Squares: Draw the clean Paper for the Copy also over with the same Number of Squares, but their Sides larger or smaller in Proportion to the intended Size of the Scale; such as one-half, one-fourth, &c. of the Length of the other. Distinguish by a stronger Line and Mark with a Figure every fifth or sixth Row of Squares in both, so that the several corresponding Squares may be readily perceived. Then, in each of the Squares of the Draught, draw, by the Eye, a Curve on the Paper similar to that in the Square in Draught, till the whole is copied, and then the Black-lead Lines may be rubbed out with Bread.

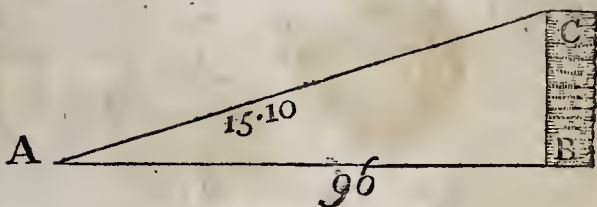
To find the Height and Distances of Objects at Sea.

When the Object is perpendicular, and the Distance to it can be measured, find the Angle of Altitude with a Quadrant, and measure the Distance to it as exact as possible, then you have the Angles and Base to find the Perpendicular; or, if you go backward or forward until the Angle of Altitude be 45° , the Distance between you and the Object will be the perpendicular Height.

E X A M P L E.

Being 96 Fathoms from the Bottom of a Tower, I find its Altitude (after allowing for the Height of my Eye above the Water) $15^{\circ} 10'$; Required the Height?

Draw $AB = 96$,
upon B erect the
Perpendicular BC ,
and draw AC mak-
ing an Angle with
 $AB = 15^\circ 10'$ till it
cuts BC in C ; then
will BC be the Height of the Tower 26.2

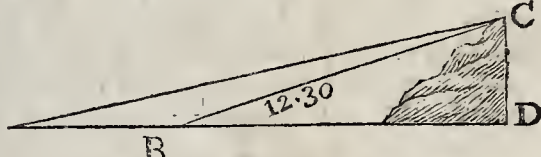


As Radius		10.00000
Is to the Dist. 96		1.98227
So is Tan. Ang.	$15^\circ 10'$	9.43308
To the Height	26.2	<u>1.41535</u>

When the Object is not perpendicular, such as Hills, Mountains, Rocks, &c. the perpendicular Height may be found by observing the Altitude at any convenient Distance, and then going either farther off or nearer to it in a straight Line, and then observing the Altitude again. With these two Angles, and the Distance between the two Stations, being carefully measured, the perpendicular Height may be found either by Geometry or Trigonometry.

E X A M P L E.

Being at Sea, I observed the Altitude of a Mountain, and found it 8° ; and then, sailing towards it in a direct Line 3 Miles, I found the Altitude of the same Mountain to be $12^\circ 30'$: Required the perpendicular Height?

Draw the Base
 AD , and at A make
the Angle $DAC =$
 8° by drawing AC . A 
Set off from A to B
3 Miles or 5280 Yards, and at B make the Angle $DBC = 12^\circ 30'$,
by drawing the Line BC to cut the Line AC in C . From C let fall
the perpendicular CD , which being measured will give the perpen-
dicular Height of the Mountain 2027 Yards. To find which by
Calculation:

Given the Angles $DAC = 8^\circ$, and $DBC = 12^\circ 30'$; then $12^\circ 30'$
subtracted from 180° leaves Angle $AEC = 167^\circ 30'$, which being
added to Angle A , 8° , the Sum $175^\circ 30'$ subtracted from 180° ,
leaves the Angle $ACB = 4^\circ 30'$, whence we have the Angles; and
one Side AB 5280 given, to find the Side AC ; then it will be,

E c

As

218 OF THE CURVATURE

As Sine Ang. B C A = $4^{\circ} 30' 8.89464$	As Radius	10.00000
Is to the Side A B $5280 \quad 3.72263$	Is to Side A C 14570	4.16333
So is S. An. A E B = $167^{\circ} 30' 9.33534$	So is Sine An. A 8°	9.14355
	13.05797	To D C 2027
	8.89464	the perpendicular Height of the
		Mountain.
To the Side A C 14570	4.16333	

In like Manner may the Height or Distance of any accessible or inaccessible Object be found, either at Sea or on Shore; and the Angles may be taken with a Quadrant, Semicircle, &c.

NOTE. The Reason why Angle B is subtracted from 180° is, because that when a Right Line meets with another Right Line and makes Angles, the two Angles will be equal to 180° . (Eucl. I. 13.)

Of the Curvature of the Earth.

Most Persons know that if they are raised above the Surface of the adjacent Land or Water, they can not only see distant Objects that lie on that Surface better, but also see those more and more remote as they advance higher. The Irregularity of the Surface of the Land will not be subjected to any one Rule that will give the Distance to which Objects may be seen at different Elevations; but at Sea, where there is generally an uniform Curvature of the Water, upon the Supposition of the spherical Figure of the Earth, those Distances may be easily computed.

RULE. To the Earth's Diameter add the Height of the Eye, multiply the Sum by that Height; then the Square Root of the Product is the Distance at which an Object on the Surface of the Water can be seen by an Eye so elevated; and by this Rule was the Table annexed computed, the Diameter of the Earth being taken at 41798117 Feet, according to Sir Isaac Newton's Measures. This Table may be usefully applied to estimate the Distance of an Object at Sea, the Elevation of that Object above its Horizon being known.

E X A M P L E I.

Sailing towards a Head-land, on which is a Light-house, elevated 600 Feet above the Surface of the Water, we saw the Lights at Night just appearing in the Horizon. How far were we at that Time distant from the Light-house?

Look in the Table for 600 Feet, in the Column marked Height in Feet, and right against it, in the Column marked Distance in Miles, stands 29,994, so that the Distance may be reckoned about 30 Miles.

E X A M.

EXAMPLE II.

Being in Company with some Merchants walking on a sandy Shore, on the Look-out for a Vessel which was then expected, whose Top-gallant-mast was 140 Feet above the Surface, Allowance being made for her Immersion in the Water; we observed, through a Telescope, a Ship's Vane just appearing in the Horizon: How far off is that Ship, supposing it the Vessel expected?

ANSWER. Against 140 Feet, the Height, stands 14.488, that is her Distance. Here is no Allowance made for the Height of the Eye above the Horizon, but it is obvious, that the higher the Eye the farther it can see. Now as Objects are seen in a straight Line, and that Line is a Tangent to the Earth's Surface; therefore, it follows, that to find the Distance of two elevated Objects, when the Right Line joining them touches the Surface of the Earth between those Objects; look for the Distance answering to each Height, and their Sum is the Distance required.

Thus, in the second Example, suppose the Eye is raised six Feet above the Water's Edge, it can see an Object on the Surface 2,999, or 3 Miles off; this Distance added to the $14\frac{1}{2}$ Miles, makes the Distance of the Ship to be $17\frac{1}{2}$ Miles.

EXAMPLE III.

A Man being on the Main-top-gallant-mast of a Man of War, 200 Feet above the Water, sees an 100 Gun Ship she had engaged the Day before, Hull-to: How far were those Ships distant?

A Ship of 100 Guns, or a first Rate Man of War, is above 60 Feet from the Keel to the Rails; from which, deduct about 20 Feet for the Draught of Water, leaves 40 Feet for the Height of her Quarter above Water: Now a Ship is seen Hull-to, when her upper Works just appear.

Then 200 Feet high gives. 17.316 Miles.

And against 40 Feet stands 7.744 Miles.

Their Sum, which is 25.060 Miles, is their Distance.

To estimate Distances by Sound, see OBLIQUE SAILING.

**A TABLE for finding the DISTANCE of TERRESTRIAL
OBJECTS at SEA.**

Height in Feet.	Dist. in Miles.	Height in Feet.	Dist. in Miles.	Height in Feet.	Dist. in Miles.	Height in Feet.	Dist. in Miles.	Height in Feet.	Dist. in Miles.
1	1,224	53	8,914	240	18,969	760	33,756	2250	53,083
2	1,732	56	9,163	245	19,165	780	34,197	2300	53,725
3	2,121	59	9,405	250	19,360	800	34,633	2350	59,360
4	2,449	62	9,641	255	19,553	820	35,063	2400	59,988
5	2,738	65	9,872	260	19,745	840	35,488	2450	60,609
6	2,999	68	10,097	265	19,932	860	35,908	2500	61,225
7	3,239	71	10,317	270	20,119	880	36,323	2550	61,834
8	3,463	74	10,533	275	20,305	900	36,734	2600	62,437
9	3,673	77	10,745	280	20,489	920	37,140	2650	63,035
10	3,872	80	10,952	285	20,671	940	37,546	2700	63,626
11	4,061	83	11,156	290	20,851	960	37,958	2750	64,213
12	4,242	86	11,355	295	21,030	980	38,332	2800	64,794
13	4,415	89	11,552	300	21,208	1000	38,731	2850	65,370
14	4,581	92	11,745	310	21,558	1030	39,297	2900	65,940
15	4,742	95	11,930	320	21,903	1060	39,866	2950	66,507
16	4,898	98	12,121	330	22,243	1090	40,426	3000	67,068
17	5,048	101	12,306	340	22,578	1120	40,978	3050	67,625
18	5,195	104	12,487	350	22,907	1150	41,524	3100	68,177
19	5,338	107	12,666	360	23,232	1180	42,062	3150	68,725
20	5,476	110	12,842	370	23,553	1210	42,593	3200	69,268
21	5,611	113	13,016	380	23,869	1240	43,118	3250	69,807
22	5,743	116	13,188	390	24,181	1270	43,636	3300	70,342
23	5,872	119	13,357	400	24,489	1300	44,149	3350	70,873
24	5,999	122	13,525	410	24,793	1330	44,655	3400	71,400
25	6,122	125	13,690	420	25,094	1360	45,156	3450	71,923
26	6,243	128	13,853	430	25,391	1390	45,650	3500	72,443
27	6,362	131	14,015	440	25,684	1420	46,140	3550	72,958
28	6,479	134	14,174	450	25,974	1450	46,629	3600	73,470
29	6,594	137	14,332	460	26,261	1480	47,106	3650	73,979
30	6,709	140	14,488	470	26,545	1510	47,581	3700	74,484
31	6,817	143	14,642	480	26,826	1540	48,052	3750	74,985
32	6,928	146	14,795	490	27,104	1570	48,517	3800	75,484
33	7,034	150	14,995	500	27,379	1600	48,979	3850	75,979
34	7,140	155	15,244	510	27,652	1630	49,436	3900	76,471
35	7,244	160	15,488	520	27,922	1660	49,889	3950	76,959
36	7,347	165	15,728	530	28,189	1690	50,338	4000	77,445
37	7,448	170	15,965	540	28,454	1720	50,782	4050	77,927
38	7,548	175	16,198	550	28,716	1750	51,223	4100	78,407
39	7,647	180	16,427	560	28,976	1780	51,661	4150	78,884
40	7,744	185	16,654	570	29,233	1810	52,094	4200	79,358
41	7,840	190	16,878	580	29,489	1840	52,524	4250	79,829
42	7,935	195	17,098	590	29,742	1870	52,951	4300	80,297
43	8,029	200	17,316	600	29,994	1900	53,374	4350	80,762
44	8,122	205	17,531	620	30,489	1930	53,793	4400	81,225
45	8,214	210	17,744	640	30,976	1960	54,210	4450	81,685
46	8,305	215	17,955	660	31,451	2000	54,761	4500	82,143
47	8,394	220	18,160	680	31,930	2050	55,441	4550	82,598
48	8,483	225	18,366	700	32,396	2100	56,113	4600	83,051
49	8,570	230	18,569	720	32,855	2150	56,777	4650	83,501
50	8,658	235	18,770	740	33,309	2200	57,434	4700	83,949

An Explanation of the most useful Sea Terms.

AFT, or *Abaft*. From the Head or Fore-part of the Ship towards the Stern; as carry such a Thing *abaft*; the Mast hangs *aft*, that is, towards the Stern.

How chear ye fore and aft? That is, how chears all the Ship's Company?

Amain; that is, yield: A Term used by a Man of War to her Enemy.

Strike amain. Lower your Top-sails.

Avast. To stop.

Aloft, signifies over Head, or above.

The Anchor is foul; that is, the Cable has got about the Fluke, which is the flat Point or Wing, that resembles the Head of an Arrow.

The Anchor is a-peak, or *a-peek*; signifying that it is directly under the Hawse or Hole through which the Cable of the Anchor runs out.

The Anchor is a-cock bell; that is, it swings or hangs up and down by the Ship's Side.

An *Awning* is a Shelter or Screen that is made of a Sail or such like, supported in the Nature of a Canopy over the Deck, to keep off the Heat of the Sun.

To bear with the Land, &c. that is, to sail towards it.

To bear-to; viz. To sail to a Channel or Harbour before or with the Wind.

Bring the Guns (or Ordnance) to bear; that is, point them right to the Mark.

Bear up; that is, make the Ship sail more close to the Wind.

Belay. Make fast any running Rope.

Bend the Sails; that is, fasten or apply them to the Yards.

Her Sails are unbent, viz. has no Sails fixed.

Bend a Cable. Make it fast to the Anchor.

A *Birth*. A convenient Place to moor a Ship in.

A *Bight*, is any Part of a Rope between the Ends.

The Ship is bilged; that is, struck off some of her Timber on a Rock or Anchor and springs a Leak.

A *Binacle*, or *Bittacle*, is that wherein the Compass stands.

To bit the Cable, is to put it round the Bits, which are two strong Pieces of Timber, in order to fasten it or slacken it gradually, which last is called veering away.

222 EXPLANATION OF THE SEA TERMS.

A Bonnet. An additional Part laced to the Bottom of the Main and Fore-sails in small Vessels in moderate Weather.

Board and Board, signifies that two Ships come so near as to touch each other.

To board a Ship, is to enter in an hostile Manner, or against the Inclination of those in her.

Booms. Certain long Poles run out from different Places of the Ship, to extend the Bottom-sails.

Bow-lines. Ropes fastened to the middle, leech, or perpendicular Edge of the Sails to keep them steady when the Ship is upon the Wind or plying to Windward.

Braces. Ropes used in wheeling the Yards and Sails about according to the Direction of the Wind.

Preventer Braces. Temporary Braces, fixed occasionally to succour the Main or Fore-yard of a Ship when they suffer an unusual Strain in a hard Gale of Wind.

Box-hauling. A particular Method of veering a Ship when the Swell of the Sea renders Tacking impracticable.

Bouce. To pull upon any Rope.

Burton. A small Tackle formed by two Blocks or Pullies till the Rope becomes three or four-fold.

To break Bulk. To open the Hold and take Goods thereout.

A Buoy is a floating Cask or such like, which is moored at a Sand-bank to warn Shipping against it; also is used to every Anchor in order to shew where the Anchor lies.

Careening, is bringing a Ship to lie down on one Side while the other is trimmed and caulked.

Cat and Fish. Machines used to draw up the Flukes of the Anchor toward the Top of the Bow in order to secure it.

Capstern or Capstain, is a strong Column of Timber, with Holes in it to receive Levers or Bars, and fixed in the Deck, that the Men by turning it round horizontally may raise up the Anchor or any great Weight, and is secured by Pawls from recoiling.

Cau'king, is driving Oakum or Spanhair, &c. into the Seams of a Ship to keep out Water.

To cun a Ship, is to direct the Person at the Helm how to steer her. If the Ship goes before the Wind, then the Pilot, or he who cuns the Ship, uses these Terms to him that steers, according as the Case requires, viz. *Starboard*, that is, to put the Helm to the Starboard (or Right) Side to make the Ship, go to the Larboard or Left Side; and so of the contrary. *Port* is to keep the same Direction of the Helm upon the Starboard or Larboard, as has been last ordered. *Helm a-midships* is to keep the Helm in a right Line with the Ship's Head and Stern, neither inclining to Right or Left. In keeping the Ship near the Wind, these Terms are used,

viz.

EXPLANATION OF THE SEA TERMS. 223

- viz. *Looff* (or *Luff*.) *Keep your Luff*; *Fall not aft*; *Veer no more*; *Keep her to*; *Touch the Wind*; *Have a Care of the Lee-latch*. To make her go more large, they say, *Easethe Helm*; *No near*; *Bear up*. To keep her upon the same Point they say, *Steady, thus, thus*; or, *As you go*; or such like. When she neither goes by a Wind nor before a Wind, but betwixt both, then they make use of some of the following Terms, which are all of the same Signification, viz. *The Ship goes Lashing, Quartering, Veering, or Large*.
- The Course*, is that Point of the Compass on which the Ship sails. *What Course did you sail on*; *What Point of the Compass*. *Courses*, signify the Ship's Sails; as, *She is under a Fore-course*; that is, sails with her Fore-mast-fails only. Under all her Courses, is under all her Sails.
- Cut the Sail*, viz. unfurl it, and let it fall down.
- Davit*. A long Beam, used as a Crane for hoisting the Flukes of the Anchor to the Top of the Bow.
- Dead-water*, signifies the Eddy-water at the Stern of the Ship.
- The Ship drives*, is when her Anchor gives way.
- Dolphin of the Mast*. A peculiar Kind of Wreath formed of plaited Cordage.
- Dunnage*. A Quantity of loose Wood laid at the Bottom of the Ship to keep the Goods from Damage.
- To hand or furl a Sail*, is to wrap it up close together, and bind it up with little Strings, called *Caskets*, fast to the Yard.
- To fash a Mast or Yard*, is to fasten a Piece of Timber or Plank, by way of Splinter, to the Mast-yard to strengthen it, which Piece or Plank is called a *Fish*.
- To lower or strike the Flag*, is to pull it down upon the Cap, and is either done in saluting with the utmost Respect, or in Token of yielding to an Enemy in Fight.
- To fall*, viz. To fall astern.
- Fore*, is forward. The Head of a Ship.
- The Ship's *Gage*, is so many Feet as she sinks in the Water, or so many Feet as she draws.
- Weather-Gage*, is when one Ship has the Wind, or is to the Weather of another.
- Goose-wings*. The Clues, or lower Corner, of a Ship's Main or Fore-fails, when the middle Part is furled or tied up to the Yard.
- The Ship gipes*, viz. turns her Head to the Wind more than she should.
- The Helm is hard a-weather*; that is, it is as hard to the Weather as it will go.
- To Hail a Ship*; to call her Company; to know whither they are bound, &c. and is thus done: *Hoa the Ship*, or only *Hoa*; to which they Answer *Hoa* likewise. To salute another Ship with Trumpets, &c. is called *Hailing*.
- An Hawser*, is the Cable belonging to the Anchor.

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Clear the Hawse, is when two Cables that come through several Hawses are twisted, and are ordered to be untwisted or freed.

To hitch, is to make fast.

The Ship heels. She inclines more to one Side than the other; as, *She heels to the Larboard*, viz. inclines to the Larboard or Left Side.

The Hold of a Ship, is the very lower Apartment or Division in the Bottom of the Ship betwixt the Keel and Lower-deck where all Goods, Storcs, &c. lie.

To rummage the Hold, is to remove or clear the Goods, &c. out of it.

To stow the Hold, is to place Goods, &c. in the Hold.

To hoist, is to haul or lift up.

The Ship labours; that is, rolls and tumbles much.

Land-fall, is expressing an Expectation of seeing Land.

Land-locked, is when a Ship lies within a Bay or Creek, and sheltered all round by the Land, so that no Point is open to the View of the Sea.

To lash, signifies to bind.

To launch a Ship, is to put her forth off the Dock into the Water; but in some Cases it is used in a negative Sense, as

Launch her, viz. Hoist no more, when a Yard is hoisted high enough, and that Orders are given to stop.

Lee-shore, is that against which the Wind blows.

She lies by the Lee; that is, a Ship has all her Sails lying flat against the Masts and Shrouds.

Leeward, is with the Wind, or on that Point towards which the Wind blows.

Lee-way, is the lateral Movement of a Ship to leeward of her Course, or the Angle which the Line of her Way makes with the Keel when she is close hauled.

Looming. A distinct Appearance of distant Objects at Sea; as Coasts, Ships, or Mountains.

Mizen has several Words peculiar to it. The *Mizen-mast* is that which stands abaft or nearest to the Stern of the Ship; and from thence every Thing belonging to that Mast is distinguished accordingly, as are all the other Masts, their Rigging, &c. So therefore the *Mizen-sail* is called the *Mizen*, and is thus understood, viz.

Set the Mizzen; that is, set the Mizzen-sail.

Change the Mizzen; bring the Yard to the other Side of the Mast.

Peck the Mizzen; that is, put the Yard right up and down the Mast.

Spell the Mizzen; let go the Sheet and peek it up.

To moor a Ship, is to lay out her Anchors in such a Manner as she may most conveniently ride with Safety.

Neap Tides, are those Tides which are in the first and last Quarter of the Moon, and are not so high, so low, nor so swift as the Spring Tides.

The Offing, is to the Seaward from the Land.

To pay a Seam, is to lay hot Pitch and Tar on (after Caulking) without Canvass.

To ride a-peek, is when the Yards are so ordered that they seem to represent a St. Andrew's Cross.

Preventer-braces. Temporary Braces fixed occasionally to succour the Main or Fore-yards of a Ship when they suffer an unusual Strain in a hard Gale of Wind.

To purchase an Anchor; that is, to loosen it so as to be able to haul it up.

The Capstern purchases a-pace, viz. Draws in the Cable a-pace.

Puddening. A thick Reef or Circle of Cordage tapering from the Middle towards the Ends, and fastened about Masts to prevent the Yards from falling down.

Quarter-winds, are when the Wind blows in abaft the Main-mast-heads even with the Ship's Quarters.

A Quoil, is a Rope or Cable laid up round, one Fake over another; and the Fake is called Quoining.

A Range, is a sufficient Length of the Cable drawn upon Deck before the Anchor is let go.

Rounding in, or pulling in several Ropes.

A Reach, is the Distance between any two Points of Land that lie in a right Line from each other.

To reeve, is to put a Rope through a Block; so, *Unreeving the Rope* is to pull the Rope out of the Block.

To ride. A Ship is said to ride at Anchor when she does not drive with the Wind or Tide, but is held fast by her Anchors.

To ride athwart, is to ride with the Ship's Side to the Tide.

To ride betwixt Wind and Tide, is when the Ship rides at Anchor, and that the Wind and Tide are contrary, and have equal Strength.

To ride Hawse-fallen, is when the Water breaks into the Hawses in a rough Sea.

A Road, is any Place near the Land where Ships may ride at Anchor, from whence a Ship so riding is called a Roder.

Rouse in, signifies to haul in, and is properly applicable only to the Hawser or Cable, in ordering it to be made straight, tight, or taught when it is slack.

To serve a Rope, is to wind something about it to preserve it from fretting or wearing.

A Service. The Thing wound about a Rope is so called.

To seize, is to make fast or bind.

She heels; that is, when on a sudden the Ship lies down on her Side, and tumbles from one Side to the other.

To settle a Deck, is to lay it lower.

Shank-painter. A short Rope and Chain which hangs the Shank and Flukes of the Anchor up to the Ship's Side.

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The Ship sheers ; that is, she goes in and out, and not right forward.
To sound, is to try with a Line or other Thing how deep the Water is.

The Ship has spent her Masts ; that is, they have been broke by foul Weather: But if a Ship lose her Masts in Fight, it is then said, *Her Masts have been shot by the Board*.

To splice Ropes ; that is, to untwist two Ends of Ropes, then twist them both together, and fasten them by binding a String about them.

The Sails are split ; that is, blown to Pieces.

Spring Tides, are the Tides at New and Full Moon which flow highest, ebb lowest, and run strongest.

The Bow-sprit sleeves, viz. Stands too upright.

Stoppers of the Cable are short Robes with a large Knot and a Laniard at the one End, and are fastened to a Ring-bolt in the Deck by the other. They are attached to the Cable by the Laniard, which is fastened securely round both, by several Turns passing behind the Knot or Nick of the Stopper, by which Means the Cable is restrained from running out of the Ship when at Anchor.

Stream Buoy. A Buoy belonging to a small Anchor in the Ship.

Streaks, the uniform Ranges of Planks on the Bottoms or Sides of Ships.

Surge the Vial, is to slacken the Rope wound about the Capstern by which the Anchor is hove up.

Tack about ; that is, bring the Ship's Head about to lie the other Way.

Tally aft the Sheets. A peculiar Term used for hauling aft the Sheets of the Main or Fore-sail.

A Windward Tide is a Tide that runs against the Wind.

Tarpaulin. A broad Piece of Canvas, well daubed, with Tar to cover the Hatch-way.

Tackle-fall. Ropes belonging to a Tackle.

A Leeward Tide, when the Wind and Tide go both one Way.

A Tide-gate is so called where the Tide runs strong.

To tide it up, is to go with the Tide against the Wind ; and on the Tide's altering, to lye at Anchor till it serves again.

It flows Tide and Half-tide ; that is, it will be High-water sooner by three Hours by the Shore than in the Offing.

To Tow ; that is, to drag any Thing after the Ship or Boat.

The Ship's Traverse, is her Way.

Veer. To haul or pull a Rope tight ; or the Wind is said to *veer* when it alters its Direction, and when a Ship changes her Course, by turning her Stern to Windward, in Opposition to Tacking wherein the Head is turned to Windward.

The Wake of the Ship, is the dead Water that follows the Ship.

To weather a Ship ; that is, to go to Windward of her.

To wind a Ship, viz. To bring her Head about.

How Winds the Ship ? that is, upon what Point of the Compass she lies with her Head.

To warp a Ship in or out of Harbour, is to carry her against the Wind by Means of carrying out an Anchor in the Boat and dropping it; then to haul upon it, and so carry out another Anchor after the Ship is come up to the first Anchor.

To woud; that is, to bind Ropes about the Mast or the like, to keep on a Fish, or strengthen it.

The Ship yaws, viz. She goes in and out, and does not steer steady.

Having, in the preceding Sheets, treated of those Parts commonly taught in Schools, and practised at Sea, which being well understood, may be thought fully sufficient for qualifying young Mariners; but as some are ambitious of knowing late Improvements made in Navigation, we shall next proceed to the Solution of those two important Problems so long wished for, viz. The New Method of finding the Latitude by two Altitudes of the Sun, and the New Method of finding the Longitude at Sea by taking the Moon's Distance from the Sun or fixed Star.

The New METHOD of finding the Latitude at Sea, by taking two Altitudes, either in the Forenoon or Afternoon, having the intermediate Time measured by a Common Watch, with Ease and Accuracy, independent of the Sun's Meridian Altitude.

GENERAL RULES.

TO the Arithmetical Complement of the Logarithm of the Co. Sine of the Latitude by Account, add the Arithmetical Com. of the Co. Sine of the Sun's Declination; call that Sum, the Logarithm Ratio.

From the Natural Sine of the greatest Altitude, subtract the Natural Sine of the least Altitude, and find the Logarithm of their Difference, and write it under the Log. Ratio.

Subtract the Hours and Minutes when the Altitudes were taken, from each other, and Half the Difference call Half-elapsed Time.

With Half the elapsed Time enter these Tables, and from the Column of Half-elapsed Time take out the Log. answering thereto, and set it down under the Log. Ratio.

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Add these three Logarithms together, and with their Sum enter the Tables, in the Column of Middle Time, where, having found the Log. nearest thereto, take out the Time corresponding to it, and put it down under Half the elapsed Time.

Subtract the Less from the Greater, and the Difference will be the Time from Noon, when the greatest Altitude was taken.

With this Time enter the new Tables, and from the Column of Rising, take out the Logarithm corresponding to it; from this Logarithm subtract the Log Ratio, the Remainder will be the Logarithm of a Natural Number; which, being found in any common Table of Logarithms, and added to the Natural Sine of the greatest Altitude, will give the Natural Sine of the Sun's Meridian Altitude.

Having the Meridian Altitude of the Sun at Noon, the Latitude is found by the usual Method.

N. B. If the Latitude, found by the above Process, should differ widely from the Latitude by Account, it will be proper to repeat the Operation; using the Latitude last found instead of the Latitude by Account, till the Result gives a Latitude nearly agreeing with the Latitude used in the Computation.

E X A M P L E I.

Being at Sea in Latitude $46^{\circ} 50'$ North by Account, when the Sun's Declination was $11^{\circ} 17'$, N. at 10 H. 2 M. in the Forenoon; the Sun's Altitude was $46^{\circ} 55'$, and at 11 H. 27 M. in the Forenoon; the Second Altitude was $54^{\circ} 7'$. Required the true Latitude, and true Time of the Day when the greatest Altitude was taken?

Times				
H. M. S.	Lat. $46^{\circ} 50'$	Arith. Co. of Co. Sine		0.16486
11 27 00				
10 2 00	Dec. 11 17	Arith. Co. of Co. Sine		0.00847
Ela. T. 1 25 00		Added gives the Log. Ratio		0.17333
El. T. 0 42 30				
The Sun's gr. Alt. at 11 H. 27 M. is $54^{\circ} 7'$	its Nat. Sine		81021	
The Sun's least Alt. at 10 H. 2 M. is $46^{\circ} 55'$	its Nat. Sine		73036	
The Remainder or Diff. of Nat. Sines				7985
Log. Ratio				0.17333
The Common Log. of the Diff. N. S.	7985			3.90227
In the New Tables in Col. $\frac{1}{2}$ -Ela. Time for 42 M. 30 S. is				0.73429
Their Sum is the Log. of Middle Time				4.80989
				The

H. M. S.

The H. M. &c. for which by the New Tables is 15 30
 Subtract Half-elapfed Time 42 30
 The Diff. is the true Space of Time the Sun had to }
 rife to the Meridian when the greateft Altitude was } 0 33 00
 taken

H. M.

Time per Watch 11 27
 Sub. from 12 00

00 33 Finding they agree, the Watch is right.

Enter the Tables with 33 M. under Col. of Rifing, and } 3.01488
 you will find the Log.
 From which fubtract the Log. Ratio 0.17333

The Natural Number of which is 694 2.84155

To the Natural Sine of the greateft Alt. 81021
 Add the Natural Number of the above Log. 694

The Sum is the Natural Sine of the Sun's Meridian } 81715
 Altitude, 54° 48'
 90° 00'
 54 48

The Sun's Zen. Diff. 35 12 } By obferving the Sun's Merid. Alt.
 The Sun's Decl. 11 17 } the fame Day the Lat. was found to be
 46° 30' N.
 Lat. 46 29 N.

NOTE. The Arithmetical Com. is found by fubtracting the Logarithmic Sine of any Number of Degrees, &c. from 10.000000.

EXAMPLE II.

Being at Sea in Lat. 47° 19' N. by Account, when the Sun's Declination was 12° 16' N. at 10 H. 24 M. A. M. per Watch, the Sun's Alt. was 49° 9', at 1 H. 14 M. P. M. his Alt. was 51° 59'. Required the Latitude?

H. M. S.	Alt.	Nat. S.	Lat.	47° 19'	0.16880
10 24 0	49° 9'	75642	Sun's Dec.	12 16	0.01003
1 14 0	51 29	78783			

Elap. T. 2 50 0	Diff. N. S.	3141	Log. Ratio	17883
			Its Log.	3.49707

$\frac{1}{2}$ El. T. 1 25 0	Its Log. in Col. of $\frac{1}{2}$ Elap. Time is	0.44077
Sub. 0 15 0	Col. of Mid. Time corresponding to	4.11667
		True

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True T. 1 10 0 Its Log. in Col. of Rifing is 3.66542
 T.p.W. 1 14 0 Log. Ratio Sub. 0.17883

Wa.falt 0 4 0 3066 the Nat. Number of this Log. 3.48659

N.S.Sun'sgr.Alt. 78783 90 00

N.S.S. Mer. Alt. 81849 = 54 56

Sun's Zen. Dist. 35 4
 Sun's Decl. 12 16 N.

Lat in 47 20 North.

Here the Latitude found by Computation may be relied on, as it differs but one Mile from that used in the Operation.

E X A M P L E III.

Being at Sea in Lat. $50^{\circ} 40'$ North per Account, when the Sun's Declination was $20^{\circ} 0'$ South, at 10 H. 17 M. A. M. per Watch, the Sun's Alt. was found $17^{\circ} 13'$, and at 11 H. 17 M. A. M. per Watch, it is found $19^{\circ} 41'$. Required the Latitude?

Times. Alt. Nat S. Lat. $50^{\circ} 40'$ 0.19803
 H. M. S. Decl. 20 00 0.02701

10 17 0 $17^{\circ} 13' = 29599$
 11 17 0 $19^{\circ} 41' = 33682$ Log. Ratio 0.22504

Ela. T. 1 0 0 Diff. N. S. 4083 Its Com. Log. 3.61098

$\frac{1}{2}$ El. T. 0 30 0 Its Log. from Col. 1 Elap. Time is 0.88430

1 01 0 In Col. of Mid. Time corresponding to 4.72032

Tr. Ti. 0 31 0 From Noon, its Log. from Col. of Rif. 2.96067

D.p.W. 0 43 0 Log. Ratio Sub. 0.22504

W.flow 0 12 0 544 N. Num. of 2.73563
 33682 N. S. greatest Alt.

90° 00'
 20 01 34226 N.S. of Sun's Mer. Alt. $20^{\circ} 1'$

Zen. Dist. 69 59
 Decl. 20 00 S.

Lat. 49 59 N.

But as this Latitude differs 41 Miles from that by Account, it will be proper to repeat the Operation, using the Lat. last found instead of the Lat. by Account.

$\frac{1}{2}$ Elapsed,

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	H. M. S.	Lat.	49° 59'	0.19178
$\frac{1}{2}$ Elapsed Time	0 30 00	Decl.	20 00	0.02701
	1 00 00			
		Log. Ratio		0.21879
True Time	0 30 00			3.61098
Time per Watch	0 43 00			0.88430
		H. M.		
Watch flow	0 13 00	In Col. Mid. T.	1 0	4.71407
True Time	0 30 0	Its Log. in Col. of Rifing is		2.93223
		Log. Ratio		0.21879
		517 Nat. Num. of		2.71344
		33682 Nat. S. great Alt.		
Nat. S. Sun's Mer. Alt:		34199 = 20° 00'		

Zen. Dist.	70 00
Decl.	20 00 S.
The Lat.	50 00 North.

The Latitude last found differing only one Mile from that used in the Operation, may be depended on as the true Latitude. Hence it is plain, that the Operation is repeated with very little additional Trouble, but few Alterations being necessary.

EXAMPLE IV.

Being at Sea in the Latitude of 60° 0' North by Account, when the Sun was on the Equator, and consequently had no Declination, at 1 H. 0 M. P. M. per Watch, his Altitude was 28° 53', and at 3 H. 0 M. P. M. per Watch, it was 20° 42'. Required the true Lat.

Times.		Lat.	60° 0' = 0.30103
H. M. S.	Alt.	N. S.	Dec. 00 00 = 0.00000
1 00 00	28 53 = 48303		
3 00 00	20 42 = 35348	Log. Ratio	0.30103
Elap. T.	2 00 00	12955	Its Log.
$\frac{1}{2}$ Elap. T.	1 00 00	Its Log. in Col of $\frac{1}{2}$ Elap. T.	4.11244
			0.58700
	2 00 00	Its Log. in Col. of Mid. T.	5.00047
T.fr.No.	1 00 00	Its Log. from Col. of Rifing	3.53243
Di. p.Wa.	1 00 00	Log. Ratio	0.30103
	1703		3.23140
	48303		

Nat. S. of Sun's Mer. Alt. 50006 = 30° 00' Sun's Mer. Alt.

60 00 Latitude.

The

The Latitude by Computation, coming the same with the Latitude by Account, shews, that the Latitude by Account was right. From the foregoing Examples, it is plain, that the Operation is the same, whether the Sun hath North or South Declination. And it will be the same whether the Ship is in a North or South Latitude. It is also clear, that when the Sun has no Declination, the Arithmetical Complement of the Log. Co. Sine of the Latitude, is the Log. Ratio.

EXAMPLE V.

July 5, 1770, wanting to go through the 8° of N. Channel, among the Maldives, and by Account being Latitude 7° 20' N. at 7 H. 25 M. 40 S. A. M. the true Altitude of the Sun's Centre was 22° 30', and at 10 H. 31 M. 48 S. A. M. it was found 63° 40'. Required the Ship's true Latitude?

H. M. S.	Alt.	Nat. S.	Lat. by Ac. 7° 20'	0.00390
Times 10 31 48	63° 40'	89623	D. July 5, 22 48	0.03533
7 25 40	22 30	38268		
			Log. Ratio	0.03923
Elap. T. 3 6 8		51355	Its Log.	4.71058
$\frac{1}{2}$ El. T. 1 33 00	Its Log. in Col. of $\frac{1}{2}$ Elap. Time is			0.40368
3 1 30			H. M. S.	
			3 1 30	5.15349
True T. 1 28 30	Its Log. in Col. of rising is			3.86709
T. p. W. 1 28 12	Log. Ratio			0.03923
Wat. fl. 0 0 18	6728 Nat. Num.			3.72786
	90 00	89623	Nat. S. gr. Alt.	
Mer. Alt. 74 29				
		96351	N. S. Sun's Mer. Alt. 74° 29'.	
Zen. Dist.	15 31			
Decl.	22 48			
Lat. in	7 17 North.			

N. B. As the Tables are only calculated to 30 Seconds, the Log. for any intermediate Seconds is found by taking the Difference between the Log. next greater and next less, and saying, as 30 Seconds is to that Difference, so is the given Seconds, to the Difference of the Logarithms or if it be any even Part, take such a Part of the Difference, and apply it to the next less Logarithm.

SECOND OPERATION.

	Lat. 7° 17'	0.00352
	Dec. 22 48	0.03533
	Log. Ratio	0.03885
H. M. S.		4.71058
3 1 30		0.40368
	H. M. S.	
1 33 00	3 1 30	5.15321
True Time 1 28 30		3.86709
N. S. gr. Alt. 89623	Log. Latio	0.03885
6734 N. Nu. Log.		3.82824
N. S. Sun's M. Al. 96357 = 74 29	Hence the Lat. in is 7° 17' N.	

The Latitude last found, agreeing with that used in the Operation, it may be taken as the True Latitude; and the Operation is repeated with very little additional Trouble, but few Alterations being necessary. Hence it is plain, that if you are mistaken in the Latitude by Account, yet by repeating the Work two or three Times, making use of the Latitude last found in the next Operation, it will at last discover itself to be true, by being equal to the last Supposition, which evidently shews the excellency of these New Tables.

In the former Examples we have considered both Altitudes taken at the same Place or Station; but as that is seldom the Case at Sea, the necessary Corrections for any Alteration of Station may be readily made, as follows:

Suppose the first Altitude in the Forenoon at	H. M.
The second Altitude in the Afternoon at 2 H. 43 M.	10 26
Difference of Longitude made is 30 Miles W. equal to	14 43
	0 2
	14 41
	10 26

Subtracted is the Elapsed Time 4 15

If a Ship has been failing to the Eastward, the above two Minutes must be added; but unless the Difference of Longitude be considerable, it is not worth Notice, as it will make a very inconsiderable Error in the Latitude.

Again, If the Ship sails or makes towards that Point of the Compass which the Sun bears upon, she must raise the Sun's Altitude as many Minutes as the Miles she has run towards it; therefore the Miles run towards the Sun must be added to the first Altitude; but if failing from the Sun, the same must be subtracted: If they are but few, they are not worth minding; and then the Seaman may make a very good Estimation by looking at the Log-board only, who, by that, will be able to ascertain the Distance failed to, or from the

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Sun, between the Observations, which will be of sufficient Exactness in the Practice of Navigation; and if the Ship makes an Angle with the Sun's Bearing, it may be readily found by the Table of Difference of Latitude and Departure, and then either add or subtract, according as the Case requires; as may be seen in the following Examples, which are inserted for the Benefit of those who require a greater Degree of Accuracy.

EXAMPLE VI.

On the 21st of December, 1772, being in a Ship from the Bay of Biscay, bound to the English Channel, in a brisk Gale running N. E. $\frac{3}{4}$ E. per Compass, at the Rate of 9 Knots per Hour, at 10 H. 00 M. A. M. per Watch, observed the Sun's Altitude $13^{\circ} 18'$ bearing South $\frac{3}{4}$ E. by Compass, and at 1 H. 40 M. P. M. per Watch, the Sun's Altitude again was found $14^{\circ} 15'$, the Latitude by Account being then $49^{\circ} 17' N.$ required the true Latitude?

The Correction to the first Altitude.

The Time of the first Observation is 10 H. 00 M. A. M. and of the Second 1 H. 40 M. P. M. the Elapsed Time is 3 H. 40 M. and the Rate of Sailing is 9 Miles per Hour; then say, by the Rule of Three, as 1 H. is to 9 Miles, so is 3 H. 40' to 33 Miles, the Distance run in the Elapsed Time.

Again, The Sun's Bearing at the first Observation is South $\frac{3}{4}$ E. the opposite Point to which is N. $\frac{3}{4}$ W. or $\frac{3}{4}$ Point, and the Ship's Course during the Ela. Time is N. by E. $\frac{3}{4}$ E. $1\frac{1}{4}$ Points, so the Angle of Ship's Course with the Sun's Bearing is $2\frac{1}{2}$ Points.

Now in the Table of Difference of Latitude and Departure, to the Course $2\frac{1}{2}$ Points, and Distance 33, the Difference of Latitude is 29, and the Ship is sailing from the Sun; therefore from the first observed Alt. $13^{\circ} 18'$, take 29, the Remainder $12^{\circ} 49'$, the first Altitude corrected, which is to be used in the Operation as follows:

H. M. S.	Alt.	Nat. S.	Lat.		
Times 10 00 00	$14^{\circ} 15'$	= 24615	Decl.	$49^{\circ} 17'$	0.18554
1 40 00	12 49	= 22183		23 28	0.03749
			Log. Ratio		0.22303
Ela. T. 3 40 00	Diff. N. S.	2432	Its Log.		3.38596
	Its Log.				0.33559
$\frac{1}{2}$ El. T. 1 50 00					
0 10 00	Time corresponding to				3.94458
1 40 00	Its Log. in Col. of Rising is				3.97170
			Log. Ratio		0.22303
90 00		5606	Nat. Num. of		3.74867
17 35		24615			
Zen. Dist. 72 25	N. S. M. Alt.	30221	= 17 35		
Decl. 23 28					
Lat. 48 57	N.				

But

THE LATITUDE AT SEA. 235

But as the Latitude by Computation differs considerably from that by Account, the Work must be repeated.

$$\begin{array}{rcl} \text{Latitude } 48^{\circ} 57' & = & 0.18262 \\ \text{Decl. } 23 \quad 28 & = & 0.03749 \end{array}$$

$$\begin{array}{rcl} \text{Log. Ratio} & & 0.22011 \\ \text{H. M. S. Diff. N. S. 2432 Its Log.} & & 3.38596 \\ \text{1 50 00 Its Log.} & & 0.33559 \end{array}$$

$$0 \quad 10 \quad 00 \quad \text{Time answering to} \quad 3.94166$$

$$\begin{array}{rcl} 90 \quad 00 & 1 \quad 40 \quad 00 \quad \text{Its Log. in Col. of Rising} & 3.97170 \\ 17 \quad 37 & \text{Log. Ratio} & 0.22011 \end{array}$$

$$\begin{array}{rcl} \text{Zen. Dist. } 72 \quad 23 & 5644 \text{ Nat. Num. of} & 3.75159 \\ \text{Decl. } 23 \quad 28 & 24615 & \end{array}$$

$$\text{Tr. Lat. } 48^{\circ} 55' \text{ N.} \quad 30259 \text{ N. S. Mer Alt. } 17^{\circ} 37'$$

This Latitude differing only 2 Miles from that used in the Computation, it may be depended upon as the true Latitude.

E X A M P L E VII.

A Ship sailing N. E. $\frac{1}{2}$ E. by Compass, at the Rate of 9 Knots an Hour, at 0 H. 31 M. 40 S. P. M. per Watch, I found the Altitude of the Sun's lower Limb $28^{\circ} 20'$ above the Horizon of the Sea, the Eye being elevated 20 Feet above the Surface of the Water, and the Sun's Bearing, by Compass, being at the same Time S. by W. and at 2 H. 58 M. 20 S. P. M. by Watch, the Altitude of the Sun's lower Limb was $16^{\circ} 41'$ above the Horizon, the Eye being elevated as before, and the Latitude by Account, at the Time of the last Observation, was $48^{\circ} 00'$ North, and the Declination $13^{\circ} 17'$ South. Required the true Latitude at taking the last Observation.

$$\begin{array}{rcl} \text{First observed Alt. of S's lower Limb } 28^{\circ} 20' & \text{Second ditto } 16^{\circ} 41' & \\ \text{Refraction to be subtracted} & 2 & 3 \\ \hline \text{Corrected for Refraction} & 28 \quad 18 & 16 \quad 38 \\ \text{Dip of the Horizon subtracted} & 4 & 4 \\ \hline \text{App. Alt.} & 28 \quad 14 & 16 \quad 34 \\ \text{Sun's Semi-diameter added} & 0 \quad 16 & 0 \quad 16 \\ \hline \text{Correct Altitudes of Sun's Centre} & 28 \quad 30 & 16 \quad 50 \end{array}$$

Correction for the first Altitude.

The Time of the first Observation 0 H. 31 M. 40 S. P. M. of the Second 2 H. 58 M. 20 S. P. M. so the Elapsed Time is 2 H. 26 M. 40 S. : the Rate of Sailing is 9 Miles per Hour. Then as 1 H. : 9 Miles, :: 2 H. 26 M. 40 S. : 22 Miles, the Distance run in the Elapsed Time.

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Again, The Sun's Bearing at the first Observation is S. by W. the opposite Point to which is N. by E. or 1 Point. The Ship's Course during the Ela. Time is N. E. $\frac{1}{2}$ E. or $4\frac{1}{4}$ Pts. So the Angle of the Ship's Course with the Sun's Bearing is. $\left. \begin{array}{l} \text{N. E. by N } \frac{1}{2} \text{ E. } 3\frac{1}{2} \text{ Pts.} \end{array} \right\}$

In the Table of Difference of Latitude and Departure, to the Course $3\frac{1}{2}$ Points, and Distance 22 Miles, the Difference of Latitude is 17 Miles, and the Ship fails from the Sun.

Wherefore, first observed Altitude $28^{\circ} 30' - 17' = 28^{\circ} 13'$ the first correct Altitude to be used in the Operation.

	H. M. S.	Alt.	N. S.	La by Ac.	48° 0'	0.17449
Times.	0 31 40	28 13	47281	Decl.	13 17	0.01178
	2 58 20	16 49	28931			
				Log. Ratio		0.18627
Ela. T.	2 26 40	Diff.N.S.	18350	Its Log.		4.26364
$\frac{1}{2}$ El. T.	1 13 20	Its Log.	from Col.	of $\frac{1}{2}$ -elapsed Time		0.50232
	1 46 30	In Col.	of Middle Time	correspond. to		4.95223
	0 33 10	Its Log.	from Col.	of Rising		3.01925
				Log Ratio		0.18627
		N.S. gr. Alt.	47281			
	90 00			687 N. Num. of		2.83298
Mer. Alt.	28 40					
		N.S. Mer Alt.	47968	= 28° 40'.		
Zen. Dif.	61 20					
Decl.	13 17					
Lat.	48 3	N.				

And as it differs but three Miles from the Latitude by Account, it may be taken as the true Latitude.

By the Ship's Course per Compass, is to be understood, its Course made good, Lec-way, if any, being first allowed, or the Course, by Compass, corrected for the Lec-way only, but not for the Variation. Had the Variation of the Compass been applied, both to the Ship's Course and the Sun's Bearing, it would not have made any Difference in the Operation or Result, as the Angle formed by them, will always be the same, whether they are both estimated by the Compass, or when the Variation is allowed on both.

Having in these Operations obtained not only the true Latitude, but also the true Time of the Day, the true Azimuth is easily determined; and as a tolerable Watch cannot be supposed to vary in the Space of one, two, or three Hours, the Azimuth may be taken at any reasonable Time afterwards, and the Variation of the Compass ascertained in a very easy and familiar Manner, without the true Latitude.

E X A M P L E.

In Latitude $51^{\circ} 40' N.$ the Sun's Declination $15^{\circ} 10' N.$ at 2 M. past Six in the Afternoon, the Sun's Altitude was $11^{\circ} 30'$. The Sun's true Azimuth is required at that Time.

As the Co. Sine of the Sun's Alt.	$78^{\circ} 30'$	9.99119
Is to the Sine of Hour from Noon	$6 \quad 2 = 90 \quad 30$	9.99998
So is the Co. Sine Sun's Decl.	$74 \quad 50$	9.98460

19.98458
9.99119

To Sine of true Azimuth $80^{\circ} 2' N.$ 9.99339

This Method of finding the Latitude is of excellent Use, since there are so many Circumstances at Sea which deny the Opportunity of having the Sun's Meridian Altitude; and as the knowing the true Latitude is of the greatest Consequence, especially in coming into the English Channel, &c. where there are frequent Obstructions of Clouds; every Seaman ought to be ready at determining his Latitude, by this Method, whenever an Opportunity offers, lest he should not see the Sun upon the Meridian.

NOTE. The nearer to Noon the Observations are taken, the better; provided the elapsed Time be not much less than half the Interval of Time, when they are both taken on the same Side of Noon, nor much greater than once and half the greater Interval, when taken on different Sides of Noon.

Of finding the Longitude at Sea.

I Have given Rules for correcting the Longitude, as far as can be done, by help of the Latitude, being truly ascertained by Observation.

Notwithstanding, as the Longitude given by Dead Reckoning, though kept and corrected with the greatest Care, is very uncertain; therefore it would be of the utmost Importance to Navigation, could it be ascertained exactly, or even within some moderate Limits: Expedients have been proposed for determining it; of these we shall only mention two or three, the rest having wholly failed.

One Expedient for determining the Longitude at Sea is the Variation Chart, first published by Dr. Halley, in the Year 1700; and since corrected by Mr. Mountaine, F. R. S. which has been found useful on many Occasions, for correcting both the Latitude and Longitude at Sea.

Another

Another Expedient was proposed about 200 Years ago, for shewing the Longitude at Sea, which is an exact Time-measurer. Could such a Piece be constructed as to move with perfect Uniformity, at all Seasons, and in all Places, such a Time-keeper being set to the Time, at any Place, (suppose London) would always shew the precise Time under the Meridian of that Place; then the Time of the Day at any other Place being found, the Difference between this Time and the Time at London, shewed by the Time-measurer, would give the Difference between the Meridian of the Place in, and London; which being converted into Longitude, by allowing 15° for one Hour, &c. would be the Difference of Longitude. The Mariner then would have nothing more to do but to provide himself one of these Time-measurers, regulated to the London Time; and when he thought proper, find the Time of the Day under his then Meridian, and to turn the Difference of Time thus found, and the Time-measurer, corrected by the Equation of Time into Longitude, which would give him his Longitude from London with great Ease and Exactness. But such Irregularities had been found in the Motions of the best Clocks and Watches, especially when exposed to the irregular violent Agitations of a Ship at Sea, and the different Temperatures of Air, and Alterations in the Power of Gravity, attending the Change of Situation and Climate, in long Voyages; that all Attempts made to determine the Longitude by their Means, proved to very little Purpose till within these few Years: Mr. John Harrison having, by long Application found Means, if not wholly to remove, at least, greatly to lessen, many of the Irregularities to which Watches of the common Construction are subject, executed a Watch so much improved, and so exact in its Motion, that in a Voyage made in the Year 1764, by Appointment of the Commissioners of Longitude, for a Trial of the Watch, from Portsmouth to Barbadoes, and from thence back to England, which took up about five Months, the Watch was found to have deviated from true mean Time only 54 Seconds: This Watch, however, has not, for some Time past, made any great Noise; and it is difficult to say what Advantage Navigation may reap from it, though it probably may reap some; but certain it is, that whatever Improvements may be made in Clocks and Watches, they, like every mechanical Movement, must ever be subject, probably to some internal constitutional Irregularities, and certainly to Injury, from various Accidents; on which Account the Mariner may, with good Reason, be diffident of them, and anxiously desirous of Means to enable him to find his Longitude, from Time to Time, with sufficient Exactness by celestial Observations.

Of finding the Longitude by celestial Observations.

Many Methods for finding the Longitude by celestial Observation have been proposed and successfully practised on Land; but none has been found so convenient at Sea, as that of observing the Moon's Distance from the Sun, or a fixed Star; both on account of the Shortness of the Moon's Period, and consequently her quick Progress in her Orbit, and also on account of her being almost constantly conspicuous, and capable of being observed.

The Moon revolves round her Orbit, or returns to the same Star from which she set out, in 27 Days, 7 Hours, 43 Minutes, and 12 Seconds: She performs her Revolution with respect to the Sun, or revolves from one Conjunction with him to another, in 29 Days, 12 Hours, 44 Minutes, and 3 Seconds; wherefore her daily mean Motion in her Orbit, being little more than 13 Degrees, and her daily mean Motion from the Sun, a little more than 12 Degrees, consequently in 2 Minutes of Time, which answers to half a Degree of Longitude, she will advance in her Orbit about one Minute, which is a very discernible Alteration of Place.

At Sea, by careful Observation, and a little Calculation, the Moon's Distance may be found from the Sun, or a proper Star; as also the Time of the Meridian of the Ship when this Distance was observed. From good Lunar Tables, the Time to the Meridian of any noted Observatory, such as Greenwich, may be found; when her Distance from the Sun, or the aforesaid Star, is the same with that found as above, and the Difference of these Times turned into Longitude, gives the Longitude of the Ship from the Observatory.

About the beginning of the fifteenth Century, John Warner made some Attempts to render this Method of finding the Longitude at Sea practicable. Dr. Halley judged it the best of all astronomical Methods for this Purpose. But as yet, two Obstacles opposed its yielding any considerable Advantage: The first was, that there was no Instrument by which the Moon's Distance from any other celestial Objects could be observed at Sea, with the necessary Degree of Exactness; the second, that there were no Lunar Tables that gave the Moon's Place with nearly sufficient Accuracy. Both these Obstacles are now happily removed: The first, by the Invention of John Hadley, Esq. who, about the Year 1730, completed that excellent Quadrant which bears his Name; and which, accommodated as it now is with Vernier's Division, and other proper Improvements, will, in the Hands of an expert Observer, give the angular Distance of any two remote Objects to a quarter of a Minute of a Degree. And the other, by the great Diligence and Care of Mr. Tobias Mayer, late Professor of Astronomy at Gottingen, who has brought the Lunar Tables to a Degree of Exactness before unknown. These Tables of Mayer's having, after his Decease, been received in Manuscript

script by the Commissioners of Longitude, and having, by their Order, been carefully compared with Dr. Bradley's Observations; and from thence received some Corrections and Additions, have lately been printed and published, under the Inspection of Mr. Maskelyne, Astronomer Royal; who assures us, that the Error in them scarce ever exceeds one Minute at most, and seldom amounts to 20 Seconds; so that the Uncertainty hence arising in the Determination of the Longitude can scarcely ever exceed half a Degree, and generally will not exceed 10 Minutes. To render Mayer's Tables of general Use, and to save the Mariner the Trouble of Calculation as much as possible, by Authority of the Commissioners of Longitude there is now annually published a Nautical Almanack, or Ephemeris, consisting of a variety of Particulars, useful both to the Navigator and Astronomer; and containing every Thing that can well be done for shortening and facilitating the Operation of finding the Longitude at Sea, by observing the Moon's Distance, from the Sun, or a Star. Every Mariner, desirous of finding his Longitude by Observation, will undoubtedly take Care to provide himself with this Almanack; which done, he may at any Time compute his Longitude as follows. And first,

To find the apparent Time at Sea, and thereby to regulate the going of the Watch.

Among the Methods proposed for this Purpose, that by equal Altitudes seems very fit to practise at Sea. At the Time when the Watch stands in need of being regulated for the Observations intended, the Ship lying by, let the Sun's Altitude be taken, and any convenient Time in the Forenoon 3, 4, or 5 Hours distant from the Meridian, set down that Time and Altitude. In the Afternoon wait for the Sun's having the same Altitude exactly, (the Index of the Quadrant being already set to the Morning Altitude) and note down the Time; then half the Sum of these two Times is the apparent Time shewn by the Clock or Watch, when the Sun was upon the Meridian of that Place.

Lest that an Altitude taken in the Forenoon cannot have a corresponding one in the Afternoon, by the interposition of Clouds, it is therefore proper to take several in the Forenoon, in order to have a greater Probability of securing a corresponding one in the Afternoon; and if several Observations of equal Altitudes can be taken on both Sides of the Meridian, it will be best to find the Noon for each Pair, and take the Mean of all the Noons thus found for the true one.

If there is Reason to believe that the Watch gains or loses considerably in a Day, other Sets of Observations should be taken on successive Days, whereby the daily Variation of the Watch may be found and allowed for; by which Means the Artist will have little
more

more to do in finding his Longitude by Observation, than to reduce the observed Distance to the true Distance of their Centres; the Ship's Time being shewn by the Watch regulated as before.

EXAMPLE I.

May 20, 1775, at 8 H. 40 M. Forenoon, and at 3 H. 16 M. Afternoon, by Watch, the Sun had equal Altitudes. Required the going of the Watch?

	H. M.
Now add together	12 00
	8 40
	3 16

Take half the Sum	23 56

Gives app. Noon	11 58
Noon per Watch	12 00

Watch too fast	2
----------------	---

March 18, 1775, being in Lat. 49° N. at 8 H. 10 M. 58 S. Forenoon, and at 3 H. 58 M. 34 S. I had equal Altitudes of the Sun. How did the Watch go?

	H. M. S.
Add together	12 0 0
	8 10 58
	3 58 34

Take half the Sum	24 9 32

Gives the app. Noon	12 4 46
Noon per Watch	12 0 00

Watch too slow	4 46
----------------	------

Another Method of finding the apparent Time at Sea.

With a good Hadley's Quadrant, well adjusted, take the Altitude of the Sun's lower Limb; take the Difference between the Sun's Semi-diameter, found in Page 3d of the Month in the Ephemeris, and the Dip of the Horizon, and add it to the observed Altitude of his lower Limb, and you have the apparent Altitude of his Centre.

From which subtract the Correction of his Altitude, as found in the Table for that Purpose, and the Remainder will be true Altitude of his Centre; hence the true Zenith Distance.

Find the Ship's Latitude and Longitude by Account, at the Time of Observation, by carrying the Reckoning forward to that Time.

Find the Sun's Declination in Page 2 of the Month in the Ephemeris; correct this Declination by the Ship's estimated Longitude, and Time from Noon of the Observation; with this correct Declination find the Polar Distance, by adding it to 90°, when the Latitude and Declination are one North, and the other South; but if both North or South, subtracting the Declination from 90°, gives the Sun's Distance from the elevated Pole. Then,

Add together the Ship's Co. Latitude, the Polar Distance, and Zenith Distance.

From half their Sum subtract the Zenith Distance, noting the said half Sum and the Difference.

H h

Then

Then to the arithmetical Co. Sine of the Latitude, add the arithmetical Co. Sine of the Polar Distance, and the Logarithms of the Sines of the half Sum and the Difference.

Half the Sum of these four Logarithms is the Co. Sine of half the Horary Angle, which being doubled gives the Horary Angle, or Distance of the Sun from the Meridian.

The Angle being turned into Time by allowing one Hour to every fifteen Degrees, &c. gives the apparent Time at the Ship, if it be in the Afternoon; but it be in the Forenoon, the Complement to 24 gives the apparent Time, counted from the preceding Noon.

EXAMPLE I.

Suppose a Ship at Sea, in Lat. $39^{\circ} 54' N.$ and Long. $35^{\circ} 30' W.$ of Greenwich, by Account, on the 7th of May, 1774, at 5 H. 30 M. P. M. by Watch, the Altitude of the Sun's lower Limb was found $15^{\circ} 45'$, by a fore Observation, the Eye being 18 Feet above the Water. What was the true apparent Time at taking the Observation.

Ob. Alt. S's lower Limb	$15^{\circ} 45' 00''$	Ship's Lat.	$39^{\circ} 54'$	
Semi-di.	$15' 53''$	Co. Lat.	$50^{\circ} 6'$	
Dip.	$4^{\circ} 3'$			H. M.
Diff. Semi-di. and Dip	$11^{\circ} 50'$	Ti. at Ship per Watch	$5^{\circ} 30'$	
		Long. p. Ac. $35^{\circ} 30' =$	$2^{\circ} 22'$	
App. Alt. Sun's Centre	$15^{\circ} 56' 50''$	Ap. ti. at Green. p. Wa.	$7^{\circ} 52'$	
Correction from Table	$3^{\circ} 8'$			
Sun's true Alt.	$15^{\circ} 53' 42''$			
Sun's true Zen. Dist.	$74^{\circ} 6' 18''$			

The Sun's Declination, May 7, at Noon, by the Ephemeris, is $16^{\circ} 54' 18'' N.$ May 8, it is $17^{\circ} 10' 39'' N.$ the daily Diff. or Decrease is $16' 21''$.

Then, as $24 : 16' 21'' :: 7 H. 52 M. : 5' 21''$, which add to $16^{\circ} 54' 18''$, the Sun's Declination the preceding Noon, gives $16^{\circ} 59' 39'' N.$ the Sun's true Declination at the Time and Place of Observation, which subtracted from 90° , leaves $70^{\circ} 0' 21''$, the polar Distance.

Co. Lat.	$50^{\circ} 6' 0''$	Ar. com Si. co. Lat.	$50^{\circ} 6'$	—	0.11511
Pol. Dist.	$73^{\circ} 0' 21''$	Ar. com. pol. Dist.	$73^{\circ} 0' 21''$		0.01940
Ze. Dist.	$74^{\circ} 6' 19''$	Sine $\frac{1}{2}$ Sum	$98^{\circ} 36' 20''$		9.99509
		Sine of Remainder	$24^{\circ} 30'$		9.61773
Sum	$197^{\circ} 12' 40''$	Sum of the four Logs.			19.74733
$\frac{1}{2}$ Sum	$98^{\circ} 36' 20''$	Co-fi. $\frac{1}{2}$ the hor. An.	$41^{\circ} 37' 2''$		9.87366
Ze. Dist.	$74^{\circ} 6' 19''$				
Diff.	$24^{\circ} 30' 1''$	The hor. Angle	$83^{\circ} 14'$	which being divided	

vided by 15, gives 5 H. 32 M. 59 S. the true Time when the Observation was taken, so the Watch was 2 M. 56 S. too slow.

The Logarithm for Degrees, Minutes, and Seconds, is found by taking the Difference between the next greater and next less Logarithm, and saying, as 60 Seconds : is to that Difference :: so is the Seconds given : to a fourth Number ; which fourth Number being added to the left Hand of the next less Logarithm, gives the Logarithm required. By the Reverse of this, when the Logarithm is given, the Seconds may be found : But if the given Seconds be 1-half, 1-3d, 1-4th, or nearly any other even Parts of a Minute, the like Parts may be taken of the Difference of the Logarithms, and added to the next less, and that will be the Logarithm of the Degrees, Minutes, and Parts of a Minute required.

The same may be observed of natural Sines.

EXAMPLE II.

January 1, 1774, in Lat. $50^{\circ} 34' S.$ and Long. $55^{\circ} 40' W.$ at 2 H. $53^{\frac{1}{2}}$ M. P. M. per Watch, the true Altitude of the Sun's Centre was $41^{\circ} 32'$. Required the true apparent Time, and Error in the Watch.

	H. M. S.	Zen. Dist.	$48^{\circ} 28'$	
Time at Ship	2 53 30	Ar. co. Co. Si. Lat.	39 26	0.19710
Sh's Lo. $55^{\circ} 40' W.$	3 32 40	Ar. co. pol. Dist	67 24	0.03586
Greenwich Ti.	6 36 10	The Sum	154 54	$\frac{1}{4}$
S's Dec. Jan. 1,	22 59 17	$\frac{1}{2}$ Sum	77 28	9.98952
Ditto ditto 2,	22 53 54	Zen. Dist. sub.	48 28	
Decr. in 24 H.	5 23	Difference	29 00	9.68557
Then as 24 H. : 5 23 ::		Sum of four Logs.		19.90805
6 H. 36 M. : 1.24,				
Decl. $22^{\circ} 59' 17''$		Si. co, $\frac{1}{2}$ hor. Angle	25 54	9.95402
Sub. Dif. in 6 H. 36 M.	1 24		2	
S's Dec. at Ship	22 57 43			H. M. S.
	90	Hor. Ang.	51 48	= 3 27 12
				H. M. S.
Polar Dist.	67 2 17	The app. Time at Noon	3 27 12	
		Time by Watch	2 53 30	
Alt. obs.	41 32	Watch slow		33 42
Zen. Dist.	48 28			
Co. Lat	39 26			

To find the apparent Time at Sea by an Observation of a Star.

Having carefully observed the Star's apparent Altitude, which correct by the Dip and Refraction, find the Ship's Latitude and Longitude by Account, at the Time of Observation, by carrying the Reckoning forward to that Time, and find the Star's right Ascension and Declination.

From the Ship's Latitude, and Star's correct Declination and Latitude, find the Co. Lat. Polar Distance, and Zenith Distance, and with these find the Hour-angle (as shewn in the last Examples of the Sun); turn this Hour-angle into Time, and apply it to the Star's right Ascension, by subtracting it when the Star is East of the Meridian, but adding it when it is West; this gives the right Ascension of the Mid. Heaven.

From the right Ascension of the Mid. Heaven (increased by 24 Hours if necessary) subtract the Sun's right Ascension at preceding Noon at Greenwich; taken from Page 2d of the Month in the Ephemeris, the Remainder is the apparent Time of the Observation, nearly at the Ship; to which apply the Longitude of the Ship from Greenwich, turned into Time, adding it when the Longitude is West of Greenwich, but subtracting it when East, and you will have the apparent Time of the Observation nearly by the Meridian of Greenwich.

Then say, as 24 Hours is to the daily Variation of the Sun's right Ascension, so is this Time to a Number of Minutes and Seconds, which subtract from the Time of Observation at the Ship, found as above, leaves the correct apparent Time at the Ship.

E X A M P L E.

Suppose at Sea, May 18, 1774, P. M. in the Latitude $33^{\circ} 43'$, and Longitude $45^{\circ} 0'$ West of Greenwich by Account, the Altitude of the bright Star in the Harp, Lyra was observed to be $36^{\circ} 3'$, the Height of the Eye above the Sea being 16 Feet. Required the apparent Time of Observation?

Alt.	$36^{\circ} 3' 0''$	Ship's Lat.	$33^{\circ} 43' N.$
Dip for 16 Feet $3' 49''$		Co. Lat.	$56^{\circ} 17'$
Refr.	$1\ 18\ \ 5\ 7$	Lyra Decl.	$38^{\circ} 35' N.$
		Polar Dist.	$51^{\circ} 25'$

True Alt. of Lyra	$35\ 57\ 53$
Zen. Dist.	$54\ \ \ 2\ \ 7$

Whence to find the Time.

Co. Lat.	$56^{\circ} 17'$	Ari. co. Si. co. Lat.	$56^{\circ} 17'$	0.07999
Polar Dist.	$51\ 25$	Ari. co. Si. pol. Dist.	$51\ 25$	0.10695
Zen. Dist.	$54\ \ 2$	Si. $\frac{1}{2}$ Sum	$80\ 52$	9.99448
Sum	$171\ 44$	Si. Difference	$26\ 50$	9.65456
$\frac{1}{2}$ Sum	$80\ 52$			
Zen. Dist. sub.	$54\ \ 2$	Sum four Logs.		19.83597
Difference	$26\ 50$	Si. $\frac{1}{2}$ hor. Angle	$34\ \ 7$	9.91798

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	H. M. S.
Hour Angle	68 14 = 4 32 56
Which subtracted from Lyra's right Ascension	18 29 17
The Rem. is the right Ascension of the Mid. Heaven	13 56 21
From which sub. the Sun's right Ascen. May 18, at Noon	3 40 55
Remains the apparent Time of Ship nearly	10 15 26
Add Ship's Longitude West of Greenwich, $45^{\circ} =$	3 0 0
Sum is apparent Time at Greenwich nearly	13 15 26
Sun's right Ascension, May 18, at Noon, is	3 40 55
Ditto, May 19,	3 44 45

Daily Diff. or Increase of right Ascension 3 59

Then say, as 24 H. : 3' 59'' :: 13 H. 15 M. 26 S. : 2' 13'', which subtracted from 10 H. 15 M. 26 S. the Time at the Ship leaves 10 H. 13 M. 13 S. the correct apparent Time at the Ship, at the Time of Observation.

NOTE 1. If an Observation of the Sun has not been taken the preceding Noon, or two Altitudes to find the Latitude, it may be ascertained by taking the Meridian Altitude of the Star, either before or after the Observation is made for finding the Time.

NOTE 2. If the Ship's Longitude East of Greenwich in Time be greater than the apparent Time at the Ship, the apparent Time must be increased by 24 Hours before subtracting the Longitude; and in this Case, the Sun's right Ascension must be taken out of the Ephemeris for one Day of the Month less than that reckoned at the Ship. And if the Ship's Longitude West of Greenwich in Time, added to the apparent Time of the Ship, makes more than 24 Hours, 24 Hours must be subtracted from the Sum, to obtain the apparent Time at Greenwich; and the Sun's right Ascension must be taken out of the Ephemeris for one Day of the Month more than that reckoned at the Ship.

The Object, whether Sun or Star, whose Altitude is taken for finding the Time, must be, at least, three or four Points of the Compass distant from the Meridian; because, near the Meridian, the Alteration in Altitude is too slow for ascertaining the Time with proper Exactness; but the nearer the Object is to the East or West the better, provided it be not less than 5° high; for as the Refraction is variable and irregular near the Horizon, less Altitudes than 5° ought not to be used, as the Effect of Refraction upon them cannot be determined with sufficient Certainty.

As often as the Moon's Distance from the Sun or Star is observed, in order to find the Longitude, the apparent Time at the Ship must be

be found. The Difference between this Time, and the Time of taking the Altitude for finding it, given by the Watch, shews the Error of the Watch, and whether it be too fast or too slow; and this Error must be carefully allowed for, in estimating the Time of taking the Moon's Distance from the Sun or Star. The less the Interval of Time between finding the apparent Time, and observing the Moon's Distance, the better; and it is the same whether it be before or after observing her Distance.

To take the Observations necessary for finding the Longitude at Sea.

The capital Observation for this Purpose is, that of the Distance of the Moon from the Sun, or some remarkable Star not far from the Zodiac. In order to make such Observations, the Observer must be furnished with a Watch that can be depended upon for keeping Time, within a Minute for six Hours; and with a good Hadley's Quadrant, or rather Sextant, which is preferable to a Quadrant. The Instrument will still be more fit for the Purpose if it be furnished with a Screw, to move the Index gradually and steadily; an additional dark Glass, lighter than the common Screens, to take off the Glare of the Moon's Light, in observing her Distance from a fixed Star; and a small Telescope magnifying three or four Times, to render the Contact of the Star with the Moon's Limb more discernible; a magnifying Glass of $1\frac{1}{2}$ or 2 Inches Focus will assist the Observer to read off his Observation with greater Ease and Certainty.

The Observer must, in the first Place, examine his Instrument with the greatest Care, and adjust it with the utmost Exactness possible; which done, let him proceed to his Observation as follows.

If the Distance of the Moon from the Sun is to be observed, turn down one of the Screens, look at the Moon directly through the transparent Part of the Horizon-glass, and keeping her there, gently move the Index till the Sun's Image is brought into the silvered Part of that Glass, bring the nearest Limbs of both Objects into Contact, and let the Quadrant librate a little on the Lunar Ray, whereby the Sun will appear to rise and fall by the Side of the Moon; in this Motion the nearest Limbs must be made to touch one another exactly, by moving the Index; when this is effected, the Observation is made; and the Division cut by the Vernier Scale will shew the Distance of the nearest Limbs of the Objects.

If the Distance of the Moon from a Star is to be observed, when the Moon is very bright, turn down the lightest Screen, or use a dark Glass, lighter than the Screens, and designed for this particular Purpose; look at the Star directly through the transparent Part of the Horizon-glass, and keeping it there, move the Index, till the Moon's Image is brought into the silvered Part of the same Glass; let the Quadrant librate gently on the Star's Ray, and the Moon will appear to rise and fall by the Star; between the Librations move the

Index,

Index, till the Moon's enlightened Limb is exactly touched by the Star, the then Observation is made.

The Quadrant is to be held as for a fore Observation, and its Plane must always be made to pass through the two Objects whose Distance is to be observed, and for that Purpose, must be put into various Positions, according to the Situation of the Objects, which will be rendered familiar by a little Experience.

At the very Instant, or at most within a very few Seconds of the Time, at which the Observer gives Notice of completing his Observation, somebody must observe the Hour, Minute, and Quarter Minute (if there be no Second Hand) of the Watch, used for finding the apparent Time; and at the same Instant of the Observer's giving the aforesaid Notice, or at the utmost within a Minute of that Time; two Assistants must take the Altitudes of the two Objects, whose Distance is observed; all which being done, the Observations necessary for ascertaining the Longitude are completed.

In the Ephemeris is found, the Moon's Distance from the Sun, and also from proper Stars, to every three Hours apparent Time, by the Meridian of Greenwich; and to afford the Mariner greater Number of Opportunities of Observation, and Means of attaining a greater Degree of Exactness, her Distance is generally set down from at least one Object on each Side of her. Her Distance from the Sun is found set down, while it is between 40° and 120° , so that by using a Sextant, it may be observed for two or three Days after her first, and before her last Quarter; while she is between 20° and 40° from the Sun, her Distance is set down only from a Star on the contrary Side to the Sun: while she is between 40° and 90° from the Sun, her Distance is set down both from the Sun and from a Star, on the contrary Side to the Sun; when she is between 90° and 120° from the Sun, her Distance is set down both from the Sun and a Star, on the same Side with the Sun, and also from a Star on the contrary Side to the Sun. Lastly, when she is above 120° from the Sun, her Distance is set down from two Stars, one on each Side of her. Her Distance from Objects on the East of her is found in the Ephemeris, in the 8th or 9th Pages of the Month; her Distance from Objects on the West of her is found in the 10th and 11th Pages of the Month.

An Observer who uses the Ephemeris, must observe the Moon's Distance from some of those Stars only, whose Distance from her is set down in the Ephemeris, and the Distances there set down afford him a ready Means of knowing the Star from which her Distance ought to be observed; for he has nothing to do but to set his Quadrant to the Distance computed roughly at the apparent Time, estimated nearly by the Meridian of Greenwich, and look to the East or West of the Moon, according as the Distance at Greenwich is found in the 8th or 9th, or in the 10th or 11th Pages of the Month, and having found the Moon upon the Horizon-glass, let him give a sweep with his Quadrant to the right or left, and he will find the Star he wants, if it be above the Horizon, and the Air be clear,

in nearly a Line perpendicular to the Line joining the Moon's Horns, or which is the same, in the Line of the Moon's shorter Axis produced.

The Time at Greenwich is estimated nearly by turning the Ship's supposed Longitude from Greenwich into Time, and adding it to, or subtracting it from, the apparent Time at the Ship; as the Ship is East or West of Greenwich; and the Distance of the Moon from the Star, at this Time, is found roughly, by saying, as 180 Minutes, the Number of Minutes in three Hours, is to the Difference in Minutes (neglecting Seconds) between this nearly estimated Time, and the next preceding Time set in the Ephemeris; so is the Difference in Minutes between the Distances in the Ephemeris, set down for the next preceding Time and the next following Time, to a Number of Minutes, which added to, or subtracted from, the Distance set down for the said preceding Time, according as it is increasing or decreasing, gives the Distance nearly at the Time the Observation is to be made, and to which the Quadrant or Sextant is to be set.

To reduce the Observed or Apparent Distance of the Moon's Limb from a Star, or from the Sun's Limb, to the true Distance of their Centres, and to find the Longitude of the Ship from Greenwich.

To the apparent Time of the Observation at the Ship, apply the Longitude turned into Time, by Subtraction or Addition, according as the Ship is East or West of Greenwich; this gives the apparent Time of the Observation, which call the *reduced Time*.

In Page the 7th of the Month, in the Ephemeris, seek the nearest Noon or Midnight preceding the reduced Time; and also the nearest Noon or Midnight following it; always taking the nearest to the reduced Time, both before and after it, whether Noon or Midnight.

Write down the Moon's Semi-diameter, and horizontal Parallax, for the preceding Noon or Midnight, and also for the following Noon or Midnight; and find the Difference between the two Semi-diameters, and between the two Parallaxes: The first of these Differences is the Variation of the Semi-diameter in 12 Hours, and the second, the Variation of the horizontal Parallax in 12 Hours; then say, as 12 Hours is to the Difference between the reduced Time and the preceding Noon or Midnight, so is the Variation of the Semi-diameter in 12 Hours to a fourth Proportional, and so is the Variation of the horizontal Parallax in 12 Hours to a fourth Proportional; these Fourths applied respectively to the Semi-diameter and Parallax, for the preceding Noon or Midnight, by Addition or Subtraction, according as the Semi-diameter and Parallax are increasing or decreasing, give the Moon's horizontal Semi-diameter and Parallax for the reduced Time.

To the Moon's horizontal Semi-diameter for the reduced Time, add the Correction answering to her observed Altitude, taken from the Table;

Table; the Sum is the true apparent Semi-diameter, at the Time and Place of Observation.

To the observed Distance of the Moon's Limb from a Star, apply the Moon's true apparent Semi-diameter, just found by Addition or Subtraction, according as the Limb, nearest to, or farthest from the Star, was observed, and you will have the apparent Distance of the Moon's Centre from the Star. But to the observed Distance of the Sun and Moon's nearest Limbs add the Sum of the Sun's Semi-diameter, taken from Page 3d of the Month in the Ephemeris, and the Moon's true apparent Semi-diameter just found, and you will have the apparent Distance of their Centres.

Take the Difference between the Sun's Semi-diameter found in the Ephemeris, and the Dip of the Horizon, and add it to the observed Altitude of the Sun's lower Limb, but subtract from the observed Altitude of his higher Limb, and you will have the apparent Alt. of his Centre. Take the Difference between the Moon's true apparent Semi-diameter and the Dip, and add it to the observed Altitude of her lower Limb, but subtract it from the observed Altitude of her higher Limb, and you will have the apparent Altitude of her Centre; and subtract the Dip from the observed Altitude of a Star, and you will have its apparent Altitude.

From the apparent Altitude of the Sun's Centre subtract the Correction to that Altitude, taken from the Table, and you will have its true Altitude; to the apparent Altitude of the Moon's Centre, add the Correction to that Altitude, and her horizontal Parallax at the reduced Time, taken from the Table, and you have the true Altitude; and from the apparent Altitude of a Star, subtract its Refraction, taken from the Table, and you will have its Altitude.

To the natural Co-sine of the Difference of the apparent Altitude of the Moon and Object from which her Distance was observed, apply the natural Co-sine of the apparent Distance of their Centres, by Subtraction or Addition, according as this Distance is less or greater than 90° , and find the Logarithm of the Remainder or Sum.

To this Logarithm add the Logarithmic Co-sines of the true Altitudes of the Objects; from this Sum subtract the Sum of the Co-sines of the apparent Altitudes; and find the natural Number corresponding to the Remainder: The Difference between this Number and the natural Co-sine of the Difference of the true Altitudes of the Objects is the natural Co-sine of true Difference required.

In the Ephemeris, among the Distances of the Objects on the Day of Observation, seek for this computed Distance, and if it be there, the Time of Observation at Greenwich is at the Top of the Columns above it; but if the computed Distance falls between two Distances in the Ephemeris, as it generally will, then say, as the Difference between the two nearest Distances in the Ephemeris, is to 3 H. so is the Difference between the first of these Distances and the computed Distance to the Time, which, added to the Time standing over the said first Distance in the Ephemeris, gives the true Time of the Observation of the Objects by the Meridian of Greenwich.

The Difference between this Time and the Time of the Observation at the Ship, being turned into Longitude, gives the Ship's Longitude from Greenwich, East or West, according as the Time at the Ship is greater or less than that at Greenwich.

EXAMPLE I.

Being at Sea, May 14, 1774, in Longitude $20^{\circ} 30'$ West of Greenwich, by Account, at 6 H. 30 P. M. by a Watch regulated before by a good Observation of the Sun's Altitude*, I observed the Distance of the Sun and Moon's nearest Limbs to be $45^{\circ} 54'$, and at the same Instant two Assistants observed; the one, the Altitude of the Sun's lower Limb $5^{\circ} 8\frac{1}{2}'$, the other, the Height of the Moon's lower Limb $42^{\circ} 18'$, the Height of the Eye being 18 Feet above the Sea. Required the Ship's true Longitude?

		H. M.
Apparent Time at Ship		6 30
Ship's Long. West of Greenwich by Acc. $20^{\circ} 30'$		1 22
Reduced Time		<u>7 52</u>
In the Ephemeris for May the 14th, 1774,		
The horizontal Parallax for that Time is	$54' 11''$	
Moon's Semi-diameter for reduced Time is		$14^{\circ} 46'$
Correction for Moon's Alt $42^{\circ} 18'$ from Table I.		<u>11</u>
Moon's true apparent Semi-diameter		14 57
Sun's ditto		<u>15 52</u>
Sum of Sun and Moon's Semi-diameters		30 49
Observed Dist. of Sun and Moon's nearest Limbs 45°		<u>5 45</u>
Apparent Distance of Sun and Moon's Centres	$45 36 34$	
Sun's App. Semid.	$15' 52''$	Moon's app. Semid. $14' 57''$
Dip for 18 Feet	<u>4 3</u>	Dip for 18 <u>4 3</u>
Diff.	11 49	Diff. 10 54
Ob. Alt. Sun's low. Limb $5^{\circ} 8 30$		Moon's ob. Alt. <u>42 18 00</u>
Sun's app. Alt.	5 20 19	
Cor. from Table I.	<u>9 16</u>	Cor. from Table II. <u>42 28 54</u>
Sun's true Alt.	<u>5 11 3</u>	
Moon's app. Alt.	42 28 54	Moon's true Alt. <u>43 6 56</u>
Sun's App.	<u>5 20 19</u>	Sun's true Alt. <u>5 11 3</u>
Diff. app. Altitudes	<u>37 8 35</u>	Diff. true Alt. <u>37 55 53</u>

LONGITUDE AT SEA.

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Nat. Co-fi. Diff. of app. Alt. $37^{\circ} 8' 35''$ 79714
 Nat. Co-fine app. Dist 45 36 34 69955

Diff. of Nat. Sines 9759 its Log. 3 98941
 Add { Co-fine Sun's true Alt. 5 11 3 — 9 99822 }
 Sum { Co-fi. Moon's tr. Alt. 43 6 56 — 9.86332 } = 19.86154

Sub. { Co-fi. Sun's app. Alt. 5 20 19 — 9.99811 } 23.85095
 Sum { Co-fi. Moon's app. Alt. 42 28 54 — 9.86774 } = 19.86585

Nat. Number to Remainder 9663 3.98510
 Nat. Co-fine Diff. true Alts. 37 55 53 = 78875

Nat. Co-fine true Dist. $46^{\circ} 12' 5''$ 69212

Now in Page 8th of the Month in the Ephemeris, I find that on
 May 14, H. H.
 Preceding nearest Dist. at 6, $45^{\circ} 18' 0''$ pre.near.Dist.at 6, $45^{\circ} 18' 0''$
 following nearest Dist. at 9, 46 38 57 Computed Dist. 46 12 5

Difference 1 20 57 Difference 0 54 5

Then say, by the Rule of Three, as 1 H. 20 M. 57 S. : 3 H. :: 54 M.
 5 S. : 2 H. 0 M 15 S. which being added to 6 Hours, the Time
 standing over the preceding Distance, gives 8 H. 0 M. 15 S. the true
 Time of the Observation at Greenwich, and the Time at Ship was
 6 H. 30 M. the Difference between these Times is 1 H. 30 M. 15 S.
 this reduced into Longitude, by allowing 15° to one Hour, gives
 $22^{\circ} 34'$ the Longitude of the Ship from Greenwich, and is West
 because the Time at the Ship is less than at Greenwich.

EXAMPLE II.

Being at Sea, May 18, 1774, in Latitude $33^{\circ} 43' N.$ and Longitude
 $45^{\circ} W.$ by Account, at 10 H. 12 M. P. M. per Watch, I observed
 the Distance of the Moon's farthest Limb from the Star Spica to be
 $50^{\circ} 27\frac{1}{4}'$, and at the same Time three Assistants observed, one the
 Altitude of the Moon's lower Limb $24^{\circ} 18' 40''$, another the Al-
 titude of Spica $45^{\circ} 13\frac{1}{4}'$, and the third, in order to find the apparent
 Time, the Altitude of the bright Star in the Harp Lyra $36^{\circ} 3\frac{1}{4}'$;
 these Observations were made with Hadley's Quadrants well ad-
 justed, the Height of the Eye above the Water being 18 Feet. Re-
 quired the Ship's true Longitude?

The true apparent Time at the Ship being computed from the
 bright Star's Declination, and Altitude with the Ship's Longitude,
 is found to be (see Page 245.) 10 H. 13 13

Ship's Long. West of Greenwich by Acc. 45 = 3 0 0

Reduced Time 13 13 13
 1 1 2 Now

Now as this Time is so near Midnight, the Moon's horizontal Parallax and Semi-diameter may be taken for that Time, as the Variation in so short a Time after Midnight, would not affect the Calculation much. Therefore,

May the 18th, the Mn's Hor. sem. is $15^{\circ} 16''$ and Hor. par. $56' 4''$
 Moon's true hor. Semi-diameter for reduced Time $15^{\circ} 16''$
 Correction from the Table I. for ob. Alt. $24^{\circ} 18' 40''$ 7

Moon's true apparent Semi-diameter $15 23$
 Obf. Distance of Moon's farthest Limb from Spica $50 27 45$

App. Distance of Moon's Centre from Spica $50 12 22$

Spica's obf. Alt. $45^{\circ} 13' 15''$ Moon's true app. Semi-di. $15 23$
 Dip for 18 Feet $4 3$ Dip for 18 Feet $4 3$

App. Alt. $45 9 12$ Diff. $11 20$
 Refr. for that Alt. 57 Moon's obf. Alt. low. Limb $24 18 40$

Spica's true Alt. $45 8 15$ App. Alt. Moon's Centre $24 30 0$
 Cor. from Table II. $48 53$

Spica's app. Alt. $45 9 12$ True Alt. Moon's Centre $25 18 53$
 Moon's app. Alt. $24 30 0$ Spica's true Alt. $45 8 15$

Diff. app. Alt. $20 39 12$ Diff. true Alts. $19 49 22$

Nat. Co-fi Diff. app. Alt. $20^{\circ} 39' 12'' - 93573$

Na. Co-fi. Dist. of Moon & Star $50 12 22 - 54003$

Diff. nat. Sines 29570 its Log. 4.47085

Add { Co-fi. Star's true Alt. $45 8 15$ 9.84844 } = 19.80459

Sum { Co-fi. Moon's true Alt. $25 18 53$ 9.95615 }

24.27544

Sub. { Co-fi. Star's app. Alt. $45 9 12$ 9.84836 } = 19.80734

Sum { Co-fi. Moon's app. Alt. $24 30 0$ 9.95902 }

Nat. Number of the Remainder 29384 4.46810

Nat. Co-fi. Diff. true Alt $19^{\circ} 49' 22''$ 94073

Nat. Co-fi. true Diff. of Moon and Star $64689 = 49^{\circ} 41' 33''$

Now in Page 10 of the Month in the Ephemeris, I find that on May 18, H.

The prec. near. Dist. at 12 is $50^{\circ} 16' 13''$ Prec. near. Dif. $50 16 13$

The following near. Dif. $48 42 9$ Computed Dif. $49 41 33$

Difference $1 34 4$ Difference $34 40$
 Then,

Then, as 1 H. 34 M. 4 S. : 3 H. :: 34 M. 40 S. : 1 H. 6 M. 20 S. which added to 12 H. the Time standing over the next preceding Distance, gives 13 H. 6 M. 20 S. the Time of the Observation at Greenwich; the Time at the Ship was 10 H. 13 M. 13 S. the Difference is 2 H. 53 M. 7 S.

Then, as 1 H. : 15° :: 2 H. 53 M. 7 S. : $43^{\circ} 16\frac{3}{4}'$, the Difference of Longitude, which is West, because the Time at the Ship is less than at Greenwich.

EXAMPLE III.

Suppose May 25, 1775, in Longitude $17^{\circ} 30'$ E. of Greenwich, by Account, at 6 H. 30 M. P. M. per Watch, regulated before by equal Altitudes of the Sun, the Distance of the Sun and Moon's nearest Limbs was observed to be $44^{\circ} 57' 30''$; at the same Time the Altitude of the Sun's lower Limb was $5^{\circ} 8\frac{1}{2}'$; and the Moon's lower Limb $42^{\circ} 18'$; the Eye being 18 Feet above the Surface of the Sea. Required the Longitude?

	H. M.
Apparent Time of the Observation at the Ship	6 30
Ship's Long. East of Greenwich, by Acc. $17^{\circ} 30'$	1 10
Reduced Time	5 20
In the Ephemeris, and for the Month of May,	
In Page 3 for the Month, the 25th, the Sun's Semi-di. is $15' 49''$	
In Page 7.	
May 25th, at Noon, Moon's hor. Semi-di. $15' 42''$	Hor. par. $57' 37''$
May 25th, at Midnight D's hor. Semi-di. $15' 38''$	Hor. par. $57' 22''$

Variation in 12 Hours 0 4 0 15
Then as 12 H. : $4''$:: 5 H. 20 M. : $1''$, and because the Semi-diameter is decreasing, $15' 42'' - 1'' = 15' 41'' =$ Moon's horizontal Semi-diameter, at the reduced Time.

And as 12 H. : $15''$:: 5 H. 20' : $6''$; and because the Parallax is decreasing, $57' 37'' - 6'' = 57' 31''$, Moon's true horizontal Parallax at the reduced Time.

Moon's hor. Semi-diameter for the reduced Time	$15' 41''$
Correction from Table I.	11

Moon's true apparent Semi-diameter	15 52
Sun's ditto	15 49

Sum of the Sun and Moon's Semi-diameters	31 41
Obs. Dist. of the Sun and Moon's nearest Limbs	$44^{\circ} 57' 30''$

Apparent Distance of Sun's and Moon's Centres	$45' 29''$
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Sun's

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Sun's app. Semi-di.	0° 15' 49"	Moon's true ap. Semi.	0° 15' 52"
Dip for 18 Feet	4 3	Dip	4 3
Difference	0 11 46	Difference	0 11 49
Obf. Alt. Sun	5 8 30	Obf. Alt. M's. lo. Lb.	42 18 00
App. Alt. Sun's Cen.	5 20 16	App. Alt. M's. Cen.	42 29 49
Cor. from Table I.	9 16	Cor. from Table II.	40 50
Cor. Alt. Sun's Centre	5 11 00	Moon's true Alt. Cen.	43 10 39
Moon's app. Alt.	42 29 49	Sun's ditto	5 11 00
Sun's ditto	5 20 16	Diff. of true Alt.	37 59 39
App. Alt.	37 9 33		
Nat. Co-fi. Diff. app. Alt.	37° 9' 33" — 79693		
Nat. Co-fi. apparent Dist.	45 29 11 — 70108		
Diff. of natural Sines	9585	its Log.	3.98159
Add { Log. Co-fi. S's. true Alt.	5 11 00 — 9.99822 }		
Sum { Log. Co-fi. M's. tr. Alt.	43 10 39 — 9.86287 }	=	19.86109
			23.84268
Sub. { Log. Co-fi. S's. ap. Alt.	5 20 16 — 9.99811 }		
Sum { Log. Co-fi. M's. tr. Alt.	42 29 49 — 9.86767 }	=	19.86588
Nat. Number of the Remainder	9480	its Log.	3.97680
Nat. Co-fi. Dif. of the true Alt.	36 59 39 — 78813		
Nat Co-fi. true Distance	46° 6' 24" = 69333		
Preceding nearest Dist.	44° 59' 40"	Preceding	44° 59' 40"
Following	43 27 40	Computed Dist.	46 6 24
Difference	1 32 00	Difference	1 6 44

Then as 1° 32' : 3 H. :: 1° 6' 44" : 2 H. 10 M. 22 S. which being added to 3 Hours, the Time standing over the preceding Distance, gives 5 H. 10 M. 34 S. the true Time at Greenwich; and the Time at the Ship was 6 H. 30 M. the Difference between these Times is 1 H. 19 M. 26 S. which turned into Longitude, gives 19° 50', and is East, because the Time at the Ship is greater than at Greenwich.

In order to obtain a greater Degree of Exactness, it will be better to repeat the Observation of the same Object, till at least three Distances, and their corresponding Altitudes and Times be obtained; but

but the more they are taken the better, only they must all be included within the Space of half an Hour; the Sum of all the observed Distances and Altitudes divided severally by the Number of Observations, gives the mean Time, Distance, and Altitude; and these Means are to be used as if they had been obtained by a single Observation, and may be depended upon with greater Certainty.

For instance, let us take the first Example from the Nautical Ephemeris, in the Year 1767, done by Mr. Maskelyne, Astronomer-royal, and by comparing the Results, we shall be able to judge of the accuracy of this Method.

EXAMPLE IV.

Suppose that at Sea, on April 4th, 1767, the Distance of the Sun and Moon's nearest Limbs, with the respective Altitudes of their lower Limbs were observed, as in the Margin, the Eye being 18 Feet above the Water, and the Ship in Latitude $34^{\circ} 17'$ N. Longitude $17^{\circ} 46'$ W. of Greenwich, by Account, the Watch not yet regulated. The Ship's true Longitude at the Time of Observation is required?

As the Watch was not regulated, the first Thing to be done is to compute the apparent Time of Observation; and the Sun being abundantly distant from the Meridian, the Mean of the three Altitudes in the Mar-

	Times.	Distances.	Sun's	Moon's
	H. M. S.	Sun & Moon.	Alt.	Alt.
	4 47 14	73 41 53	22 50	80 17
	4 50 11	73 43 55	22 12	80 36
	4 55 26	73 47 33	21 6	81 9
Sum	14 33 51	221 13 21	66 8	242 2
Means	4 50 57	73 44 27	22 3	80 41

gin may be supposed preferable to any single Observation for that Purpose: Wherefore to the observed Altitude of the Sun's lower Limb, $22^{\circ} 3'$, and $11' 58''$, (the Difference between his Semidiameter found in the Ephemeris, $16' 1''$, and the Dip on 18 Feet $4' 3''$), the Sum $22^{\circ} 14' 58''$ is the apparent Altitude of his Centre, from which subtracting $2' 11''$, the (Correction to that Altitude, taken from Table I.) there remains $22^{\circ} 12' 47''$ from the Sun's true Altitude. The Time by Watch is 4 H. 50 M. 57 S. to which add 1 H. 11 M. 4 S. the Longitude by Account West of Greenwich in Time, and you have 6 H. 2 M. 1 S. for the Time of Greenwich estimated nearly; and to this Time the Declination is found to be $5^{\circ} 48' N.$ From the Altitude, Declination, and Latitude, now all known, the Time of the Mean of the Observation is found to be 4 H. 28 M. 19 S.

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Time at Ship 4 28 00 Hor. Par. at Noon 56 24
 Long. per Acc. 1 11 04 Hor. Par. at Midnight 56 1

Ap. Time at Green. 5 39 04 23 $\frac{1}{2}$ = 11" Dif.
 Horiz. Semi-di. 15 19, hor. Par. at redu. Time 56 12

Horizontal Semi-diameter 15 19
 16

Moon's Semi-diameter 15 35
 Sun's Semi-diameter 16 01

Sum 31 36
 Distance 73 44 27

App. Diff. Cen. 74° 16' 3"

Obf. Alt. Moon's 80° 41' 00" Obf. Alt. Sun 22° 3' 0"
 Diff. Sem. and Dip 11 32 Diff. Semi-di. and Dip 11 58

App. Alt. Cen. 80 52 32 App. Alt. Centre 22 14 58
 Correction 8 46 Correction 2 11

True Alt. Centre 80 1 18 True Alt. Sun's Cen. 22 12 47
 Tr. Alt. Moon's Cen. 81 1 18

Moon's app. Alt. 80 52 32
 Sun's app. Alt. 22 14 58 Difference 58 48 31

Difference 58 37 34

Nat. Co-fi. Diff. app. Alt. 58° 37' 34" — 52063
 Nat. Co-fi. app. Distance 74 16 3 — 27114

Sum { Co-fi. M's. true Alt. 81 01 18 — 9.19333 } 24949 its Log. 4.39707
 Add { Co-fi. Sun's true Alt. 22 12 47 — 9.96651 } = 19.15984

Sum { Co-fi. M's. app. Alt. 80 52 32 — 9.20027 } 23.55691
 Sub. { Co-fi. S's. app. Alt. 22 14 58 — 9.96640 } = 19.16667
 Nat. Number to the Remainder 24560 its Log. 4.39024
 Sub. nat. Co-fi. Diff. true Alt. 58 48 31 — 51790

Nat. Co-fi. true Distance 74 11 56 27230
 Preceding nearest Dist. 73° 1' 27" Prec. nearest Dist. 73° 1' 27"
 Next nearest Dist. 74 28 50 Computed Dist. 74 11 56

1 27 23

1 10 29
 . Then

Then say, as 1 H. 27 M. 23 S. : 3 H. :: 1 H. 10 M. 29 S. : 2 H. 25 M. 11 S. which added to 3 Hours, gives 5 H. 25 M. 11 S. the Time at the Ship was 4 H. 28 M. 19 S. therefore the Difference is 56' 52"; now as 60' : 15° :: 56' 41" : 52° 13' the Longitude required, and is West, because the Time at the Ship is less than at Greenwich, differing from the Longitude found by the Astronomer-royal $\frac{3}{4}$ of a Mile.

The Distance of the Moon from the Sun, or from a Star, well observed with a good Instrument, together with the Time of the Observation, and the Altitudes of the two Objects, is sufficient to determine the Longitude, with the help of the Ephemeris and the preceding Method of Calculation, always within a Degree, and generally nearer; but it will conduce to still greater Accuracy, if the Observer takes the Moon's Distance from two Stars, or from the Sun and a Star, or when the Moon is between 90° and 120° from the Sun, and two Stars, if he can be so lucky as to obtain the several Observations; observing the Moon's Distance from each Object, two, three, or more Times.

For the Longitude being computed from the Set of Observations made with each Object respectively, the Mean of the Results will probably approach nearer to the Truth than any one Result separately. Particularly the Moon's Distance should be taken from an Object on each Side of her as often as there is Opportunity; and the Mean of the Results from hence will probably be as exact again, as either by itself, especially so far as depends upon any Imperfection of the Instruments, and unavoidable small Errors in the use of them; for Errors of these Kinds have a natural Tendency to correct each other: And in this Case there will be good Reason to believe that the true Longitude is somewhere between the two Results, or between the extreme Results, if there are more than two Sets of Observations.

Suppose that at Sea, in Latitude 17° 48' S. Longitude 64° 32' E. of Greenwich, which by Account, on September 5, 1767, the Distance of the Moon's farthest Limb from the Star Pegasi Markab, with the Altitude of the Star, and of the Moon's lower Limb

	Times.	Distances Moon & Star.	Moon's Alt.	Star's Alt.
	H. M. S.	° ' "	° ' "	° ' "
	14 50 30	44 53 48	15 22	35 22
	14 55 35	44 50 49	14 11	34 15
	15 0 0	44 48 14	13 8	33 17
	15 5 50	44 44 48	11 46	32 1
	15 11 15	44 41 37	10 30	30 50
Sum	75 3 10	223 59 16	64 57	165 45
Means	15 0 38	44 47 51	12 59	33 9

were observed, as in the Margin, the Eye being 12 Feet above the Water, and the Watch not regulated. Required the Ship's true Longitude at the Time of Observation?

The Star being at a sufficient Distance from the Meridian; its mean Altitude with the mean Time in the Margin will serve for regulating the Watch, or finding the true apparent Time without a separate Observation for that Purpose.

Wherefore from the Star's mean Altitude observed $33^{\circ} 9'$, subtract the Dip for 12 Feet $= 3' 18''$, and you have the Star's apparent Altitude $33^{\circ} 5' 42''$, from which, subtracting the Refraction $1' 28''$, there remains $33^{\circ} 4' 14''$, the Star's true Altitude. The Star's Declination taken from the Table, and fitted to the Beginning of September, 1767, is $15^{\circ} 57' 34''$ N. and from the Altitude, Declination, now all known, the Polar Angle or Star's Distance from the Meridian is found to be $47^{\circ} 54\frac{1}{4}' = 3$ H. 11 M. 38 S. The Star's right Ascension taken from the Table, and fitted to the Beginning of September, 1767, is 22 H. 53 M. 13 S. to which adding the Polar Angle 3 H. 11 M. 38 S. because the Star is West of the Meridian, you have 26 H. 4 M. 51 S. the right Ascension of the Mid-heaven. From this Sum subtract the Sun's right Ascension for the preceding Noon found in the Ephemeris, viz 10 H. 55 M. 51 S. and there remains 15 H. 9 M. the apparent Time of Observation at the Ship nearly, from which subtracting 4 H. 18 M. 8 S. the Longitude East of Greenwich by Account turned into Time, you have 10 H. 50 M. 52 S. the apparent Time of Observation by the Meridian of Greenwich nearly. Then, as 24 H. : 10 H. 50 M. 52 S. :: 3 M. 37 S. the daily Variation of the Sun's right Ascension at the given Time, 1 M. 38 S. which subtracted from 15 H. 9 M. leaves 15 H. 7 M. 22 S. the correct Time of Observation at the Ship.

To 10 H. 50 M. 52 S. the apparent Time of Observation at Greenwich nearly, the Moon's horizontal Semi-diameter is found from the Ephemeris to be $16' 29''$, and her horizontal Parallax $60' 32''$, add 4 to the Semi-diameter on account of the Altitude $12^{\circ} 59'$, and you have $16' 33''$, the Moon's true apparent Semi-diameter, which, subtracted from $44^{\circ} 47' 51''$, the Mean of the observed Distances of the Moon's farthest Limb from the Star, leaves $43^{\circ} 31' 18''$, the apparent Distance of the Moon's Centre from a Star. To the Mean of the observed Altitudes of the Moon's lower Limb $12^{\circ} 59'$ add $13' 15''$, the Difference between her true apparent Semi-diameter $16' 33''$, and the Dip $3' 18''$, and you have $13^{\circ} 12' 15''$, the apparent Altitude of her Centre; to which adding $54' 57''$, the Correction to that Altitude taken from the Table, you have $14^{\circ} 7' 12''$, the true Altitude of her Centre.

The apparent Distance of the Objects, with the apparent and also the true Altitude of each of them are now known, from whence computing as before, their true Distance is found to be $40^{\circ} 0' 24''$.

In the Ephemeris, the next preceding Distance is $45^{\circ} 6' 40''$, at 9 Hours, the next following Distance at 12 Hours $43^{\circ} 24' 24''$, their Difference $1^{\circ} 42' 16''$, and the Difference of the next preceding $45^{\circ} 6' 40''$, and the computed Distance $44^{\circ} 0' 24''$ is $1^{\circ} 6' 16''$.

Then,

Then, as 1 H. 42' 16" : 3 H. :: 1° 6' 16" : 1 H. 56 M. 38 S. which added to 9 Hours, gives 10 H. 56 M. 38 S. the Time of the Mean of the Observation at Greenwich, and the Time at the Ship was 15 H. 7 M. 22 S. The Difference 4 H. 10 M. 44 S. = 62° 41', is the Ship's Longitude from Greenwich East, because the Time at Ship is greater than at Greenwich, differing from the Longitude found by the Astronomer-royal $\frac{1}{2}$ a Milè.

I cannot quit this Subject without observing another Method of determining the Longitude at Sea; and though not equal to the former, yet it may sometimes be practised with Success.

Let the Watch be carefully regulated as before directed, either by the Sun or a Star. By taking equal Altitudes of the Moon, find the Time of her Passage over the Meridian; take the Difference between this Time and the next nearest Time of her Passage over the Meridian, found in the Ephemeris, and also the Difference between her Passage over the Meridian the preceding and following Days; then say, as 24 H. : is to this Difference, :: so is the Difference of Time between her Passage over the Meridian in the Ephemeris, and that by Observation, : to a fourth Number; which being applied to the Time of Observation at the Ship, by Addition or Subtraction, according as the Time at the Ship is more or less than that set down in the Ephemeris, gives the true Difference of Time between her Passage over the Meridian at the Ship and Greenwich, which reduced into Longitude, gives the Longitude East or West of Greenwich.

Suppose, by taking the Mean of three Altitudes on the 2d of December, 1775, the Moon was found to pass over the Meridian at 9 H. 15 M. P. M. the Watch being well regulated. Required the Longitude?

In the Ephemeris, and for	H. M.	H. M. S.
Nov. 2, the Moon passes the Mer, at	8 36 P. M.	Moon's Passage 8 36 0
Nov. 3,	at 9 26	Obs. Ti. at Ship 9 15 0

Difference in 24 Hours	0 50	Diff. between Ship & Gre. 39
Then as 24 H. : 50 M. :: 39 M. : 1 M. 21 S.		the Diff. in 39 Min. add 1 21
True Difference of Time between Ship and Greenwich		0 40 21

Then 60 M. : 15° :: 40 M. 21 S. : 10° 5' the Longitude, and is West because the Time of her Passage over the Meridian at Ship, is after that at Greenwich. Had the Time been before Greenwich Time, 1 M. 21 S. must have been subtracted, and the Longitude would have been East.

T A B L E I.

A Table of Corrections for reducing the Moon's Semi-diameter to the true Semi-diameter; and also a Table for reducing the Sun's Altitude to the true Altitude from the Earth's Centre.

Apparent Altitude.	Cor. to be added to the Moon's app. Semi-di.	Cor. to be subtr. from the Sun's Altitude.	Apparent Altitude.	Cor. to be added to the Moon's Semi-diameter.	Cor. to be subtr. from Sun's Altitude.
0	"	"	0	"	"
1	0	32 51	45	11	51
2	0	24 20	46	12	49
3	1	18 26	47	12	47
4	1	14 27	48	12	45
5	1	11 42	49	12	43
6	2	9 45	50	12	52
7	2	8 19	51	12	40
8	2	7 11	52	13	39
9	2	6 20	53	13	37
10	2	5 39	54	13	36
11	3	5 6	55	13	35
12	3	4 38	56	13	33
13	3	4 14	57	13	32
14	4	3 54	58	14	30
15	4	3 36	59	14	29
16	4	3 21	60	14	28
17	5	3 8	61	14	27
18	5	2 55	62	14	26
19	5	2 45	63	14	25
20	5	2 35	64	14	24
21	5	2 27	65	14	22
22	6	2 19	66	15	21
23	6	2 12	67	15	20
24	6	2 6	68	15	19
25	7	2 0	69	15	18
26	7	1 54	70	15	17
27	7	1 48	71	15	16
28	7	1 43	72	15	15
29	8	1 39	73	15	14
30	8	1 34	74	15	14
31	8	1 30	75	15	13
32	8	1 27	76	16	12
33	8	1 23	77	16	11
34	9	1 20	78	16	10
35	9	1 17	79	16	9
36	9	1 14	80	16	8
37	9	1 11	81	16	8
38	10	1 9	82	16	7
39	10	1 6	83	16	6
40	10	1 5	84	16	5
41	10	1 1	85	16	4
42	11	58	86	16	3
43	11	56	87	16	3
44	11	54	88	16	2
45	11	53	89	16	1
		51	90	16	0

The Corrections of the Moon's Semi-diameter are the natural Sines of her Altitude, the Radius being 16, which is nearly the Moon's mean Semi-diameter, and are to be added, because in ascending from the Horizon to the Zenith, she approaches nearer to the Observer by a Semi-diameter of the Earth, or about one sixtieth Part of her Distance from the Earth.

The Corrections of the Sun's Altitude are the Difference between the Refraction at each Degree of Altitude and his Parallax at that Altitude, and is to be subtracted from the apparent Altitude.

The Corrections are only set down for Degrees, but may be found for any intermediate Minutes, by taking proportional Parts, or saying as 60 is to the Difference between the next greater and next less Correction, so is the Minutes given to a fourth Number, which being subtracted from the Correction of the next less Altitude, gives the Correction required.

Thus the Corrections of Sun's Altitude for $5^{\circ} 20'$ is required?

For Altitude 5° the Correction is	9' 45"
6 the Correction is	8 19

The Differences	1 26
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Then, as $60' : 1' 26'' :: 20' : 29''$, which subtracted from $9' 45''$, leaves $9' 16''$, the Correction for $5^{\circ} 20'$ Altitude; or if the Third of the Difference be taken and subtracted as above, it will be the same.

The Parallax is the Difference between the Places in which the Sun or Moon appear, when seen from any Part of the Earth's Surface; and the Places in which they would appear, if seen at the same Time from the Earth's Centre; or the Parallax of the Sun or Moon is the Angle under which the Earth's Semi-diameter would appear, if seen from the Sun or Moon. Now as the Sun or Moon are elevated above their true Height by Refraction of the Atmosphere, so they are depressed by their Parallax; and as they must appear higher when viewed from the Earth's Centre, than they would appear when viewed from the Surface thereof: To save the Mariner Trouble, the Difference is set down in these Tables, which applied to the observed Altitude of their Centres, gives the true Altitudes, as seen from the Earth's Centre.

The Use of the following Table.

THE Corrections of the Moon's Altitude are set down only to each Degree of Altitude, and Minute of horizontal Parallax; but they may easily be found to intermediate Minutes of Altitude, and Seconds of horizontal Parallax, as follows:

1st. When the horizontal Parallax is given in Minutes without Seconds, and the Altitude in Degrees and Minutes; for Example,

The Moon's apparent Altitude was $24^{\circ} 31'$, when her horizontal Parallax was $59'$. Required the Correction of her Altitude?

Find the Correction of Altitude for horizontal Parallax $59'$, and Altitude $\left\{ \begin{smallmatrix} 24^{\circ} 00' \\ 25 \quad 00 \end{smallmatrix} \right\}$ which will be $\left\{ \begin{smallmatrix} 51' 47'' \\ 51 \quad 27 \end{smallmatrix} \right\}$ and subtracting the lesser from the greater, the Difference is $0' 20''$; then say, as $66 : 31' : 0 : 0' 20'' : 0' 10''$, which subtracted from $51' 47''$, because the Correction for the greater Altitude is least, gives $51' 37''$, the Correction required.

But had the Correction for the greater Altitude been greatest, as is the Case at low Altitudes, then the Difference $0' 10''$, must have been added.

2dly. When the Altitude is given in Degrees, and the horizontal Parallax in Minutes and Seconds, for Example, the Moon's apparent Altitude was 24° , when her horizontal Parallax was $59' 21''$. Required the Correction of her Altitude?

Find the Correction of Altitude for Altitude 34° and horizontal Parallax $\left\{ \begin{smallmatrix} 59' \\ 60 \end{smallmatrix} \right\}$ which will be $\left\{ \begin{smallmatrix} 51' 47'' \\ 52 \quad 42 \end{smallmatrix} \right\}$ and subtracting the lesser from the greater, the Difference is $0' 55''$; then say, as $60'' : 21'' :: 55'' : 19''$, which added to $51' 47''$, gives $52' 06''$, the Correction required.

3dly. When the Altitude is given in Degrees and Minutes, and the horizontal Parallax in Minutes and Seconds, for Example, the Moon's apparent Altitude was $24^{\circ} 31'$, when her horizontal Parallax was $59' 21''$. Required the Correction of her Altitude?

By last Case, the Correction of Altitude for horizontal Parallax $59' 21''$, and Altitude $\left\{ \begin{smallmatrix} 24^{\circ} \\ 25 \end{smallmatrix} \right\}$ is found to be $\left\{ \begin{smallmatrix} 52' 06'' \\ 51 \quad 46 \end{smallmatrix} \right\}$ and subtracting the lesser from the greater, the Difference is $0' 20''$; then say, as $60' : 31' :: 0' 20'' : 0' 10''$, which subtracted from $52' 06''$, because the Correction to the greatest Altitude is least, gives $51' 56''$, the Correction required.

T A B L E II.

A Table of the Difference between the Moon's Parallax and Refraction at each Degree of Altitude and Minutes of Horizontal Parallax.

HORIZONTAL PARALLAX.											
	53	54	55	56	57	58	59	60	61	62	
alt	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	alt
0	20 0	21 0	22 0	23 0	24 0	25 0	26 0	27 0	28 0	29 0	0
1	28 31	29 31	30 31	31 31	32 31	33 31	34 31	34 31	36 31	37 31	1
2	34 23	35 23	36 23	37 23	38 23	39 23	40 23	41 23	42 23	43 23	2
3	38 20	39 20	40 20	41 20	42 20	43 20	44 20	45 19	46 19	37 19	3
4	41 1	42 1	43 1	44 1	45 1	46 1	47 1	48 1	49 1	50 1	4
5	42 55	43 54	44 54	45 54	46 54	47 55	48 54	49 53	50 53	51 53	5
6	44 15	45 14	46 14	47 14	48 13	49 13	50 13	51 12	52 12	53 12	6
7	45 10	46 10	47 10	48 10	49 10	50 10	51 10	52 10	53 10	54 10	7
8	46 0	46 59	47 59	48 58	49 58	50 57	51 57	52 56	53 55	54 55	8
9	46 33	47 32	48 31	49 31	50 30	51 29	52 28	53 28	54 27	55 26	9
10	46 57	47 57	48 56	49 55	50 54	51 53	52 52	53 51	54 50	55 49	10
11	47 15	48 14	49 13	50 12	51 11	52 10	53 9	54 8	55 7	56 6	11
12	47 27	48 26	49 25	50 24	51 22	52 21	53 20	54 18	55 17	56 16	12
13	47 35	48 34	49 32	50 31	51 29	52 28	53 26	54 25	55 23	56 22	13
14	47 41	48 40	49 38	50 36	51 34	52 33	53 31	54 29	55 27	56 25	14
15	47 42	48 40	49 38	50 36	51 34	52 32	53 30	54 28	55 26	56 24	15
16	47 40	48 38	49 35	50 33	51 31	52 28	53 26	54 24	55 21	56 19	16
17	47 37	48 34	49 32	50 29	51 27	52 24	53 21	54 19	55 16	56 13	17
18	47 31	48 28	49 25	50 22	51 19	52 16	53 13	54 10	55 7	56 4	18
19	47 23	48 20	49 16	50 13	51 10	52 6	53 3	54 0	54 57	55 53	19
20	47 13	48 10	49 6	50 2	50 59	51 55	52 52	53 48	54 44	55 41	20
21	47 2	47 58	48 58	49 50	50 40	51 42	52 38	53 38	54 30	55 20	21
22	46 48	47 44	48 40	49 35	50 31	51 27	52 22	53 18	54 13	55 9	22
23	46 33	47 29	48 24	49 19	50 14	51 10	52 5	53 0	53 55	54 51	23
24	46 18	47 13	48 8	49 2	49 57	50 52	51 47	52 42	53 37	54 31	24
25	46 0	46 55	47 49	48 44	49 38	50 32	51 27	52 21	53 15	54 10	25
26	45 42	46 36	47 30	48 24	49 18	50 12	51 6	52 0	52 54	53 48	26
27	45 22	46 19	47 9	48 3	48 56	49 50	50 43	51 37	52 30	53 24	27
28	45 1	45 54	46 47	47 40	48 33	49 26	50 19	51 12	52 5	52 58	28
29	44 39	45 32	46 24	47 17	48 9	49 2	49 54	50 47	51 39	52 32	29
30	44 15	45 8	46 0	46 52	47 44	48 36	49 27	50 20	51 11	52 3	30
31	43 51	44 43	45 34	46 25	47 17	48 8	49 0	49 51	50 43	51 34	31
32	43 26	44 17	45 8	45 58	46 49	47 40	48 31	49 22	50 13	51 4	32
33	42 59	43 50	44 40	45 30	46 21	47 11	48 1	48 52	49 42	50 32	33
34	42 32	43 22	44 12	45 2	45 51	46 41	47 31	48 21	49 10	50 0	34
35	42 4	42 53	43 42	44 31	45 21	46 10	46 50	47 48	48 37	49 26	35
36	41 35	42 23	43 12	44 0	44 49	45 37	46 26	47 14	48 3	48 52	36
37	41 4	41 53	42 40	43 28	44 16	45 4	45 51	46 39	47 27	48 15	37
38	40 33	41 20	42 7	42 55	43 42	44 29	45 17	46 4	46 51	47 39	38
39	40 1	40 48	41 35	42 21	43 8	43 54	44 41	45 28	46 14	47 1	39
40	39 28	40 14	41 0	41 46	42 32	43 18	44 4	44 50	45 36	46 22	40
41	38 55	39 40	40 20	41 14	41 56	42 41	43 27	44 12	44 58	45 43	41
42	38 20	39 5	39 49	40 34	41 19	42 3	42 48	43 32	44 17	45 2	42
43	37 45	38 29	39 12	39 56	40 40	41 24	42 8	42 52	43 36	44 20	43
44	37 8	37 52	38 35	39 18	40 1	40 44	41 27	42 11	42 54	43 37	44
45	36 32	37 14	37 55	38 20	39 29	40 4	40 46	41 20	42 11	42 52	45

A Table of the Difference between the Moon's Parallax and Refraction at each Degree of Altitude and Minutes of Horizontal Parallax.

CORRECTION of the MOON'S ALTITUDE:

HORIZONTAL PARALLAX.																							
53		54		55		56		57		58		59		60		61		62					
alt	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	alt			
45	36	32	37	14	37	56	38	39	39	21	40	4	40	46	41	29	42	11	42	53	45		
46	35	54	36	36	37	17	37	59	38	41	39	22	40	4	40	46	41	27	42	9	46		
47	35	16	35	57	36	38	37	19	37	59	38	40	39	21	40	4	40	43	41	24	47		
48	34	37	35	17	35	57	36	37	37	17	37	58	38	38	38	18	9	58	40	38	48		
49	33	57	34	37	35	16	35	55	36	35	37	14	37	55	38	33	39	12	39	52	49		
50	33	16	33	55	34	34	35	12	35	51	36	20	37	8	37	46	38	25	39	3	50		
51	32	35	33	13	33	51	34	29	35	0	35	44	36	24	37	0	37	57	38	15	51		
52	31	54	32	31	33	8	33	45	34	22	34	58	35	35	36	12	36	49	37	26	52		
53	31	11	31	47	32	23	32	59	33	36	34	12	34	4	35	24	36	0	36	36	53		
54	29	28	31	3	31	39	32	14	32	49	33	24	34	0	34	31	35	10	35	46	54		
55	29	44	30	19	30	53	31	28	32	2	32	36	33	11	33	45	34	30	34	54	55		
56	29	0	29	34	30	7	30	41	31	14	31	40	32	22	32	55	33	29	34	2	56		
57	28	15	28	48	29	20	29	53	30	26	30	58	31	31	32	4	32	36	33	9	57		
58	27	30	28	2	28	34	29	6	29	37	30	9	30	41	31	13	31	44	32	16	58		
59	26	44	27	15	27	46	28	17	28	47	29	16	29	49	30	20	30	51	31	22	59		
60	25	57	26	27	26	57	27	27	27	57	28	27	28	57	29	27	29	57	30	28	60		
61	25	10	25	39	26	8	26	37	27	6	27	35	28	4	28	34	29	3	29	30	61		
62	24	23	24	31	25	19	25	47	26	16	26	44	27	12	27	40	28	8	28	36	62		
63	23	35	24	2	24	29	24	56	25	23	25	51	26	18	26	45	27	13	27	40	63		
64	22	46	23	12	23	39	24	5	24	31	24	58	25	24	25	50	26	17	26	43	64		
65	21	58	22	23	22	49	23	14	23	39	24	5	24	30	24	55	25	21	25	46	65		
66	21	9	21	33	21	37	22	22	22	46	23	10	23	35	23	59	24	24	24	48	66		
67	20	19	20	42	21	5	21	29	21	52	22	16	22	39	23	3	23	26	23	50	67		
68	19	28	19	52	20	13	20	36	20	53	21	21	21	43	22	6	22	28	22	51	68		
69	18	38	18	59	19	21	19	42	20	4	20	25	20	47	21	8	21	30	21	51	69		
70	17	47	18	7	18	28	18	48	19	9	19	29	19	50	20	11	20	31	20	52	70		
71	16	30	17	16	17	35	17	55	18	14	18	34	10	55	19	13	19	33	19	52	71		
72	16	5	16	23	16	42	17	0	17	19	17	37	17	56	18	14	18	33	18	52	72		
73	15	13	15	30	15	48	16	5	16	23	16	40	16	58	17	16	17	33	17	51	73		
74	14	21	14	37	14	54	15	10	15	27	15	43	16	0	16	16	16	33	16	49	74		
75	13	28	13	44	13	50	14	15	14	30	14	46	15	1	15	17	13	32	15	48	75		
76	12	35	12	50	13	4	13	19	13	33	13	48	14	2	14	17	14	31	14	40	76		
77	11	42	11	56	12	9	12	23	12	36	12	50	13	3	13	17	13	50	13	44	77		
78	10	49	11	2	11	14	11	27	11	29	11	52	12	4	12	16	12	29	12	41	78		
79	9	56	10	7	10	19	10	30	10	42	10	53	11	4	11	16	11	27	11	39	79		
80	9	2	9	13	9	23	9	32	9	44	9	54	10	5	10	15	10	26	10	36	80		
81	8	8	8	18	8	27	8	37	8	46	8	55	9	5	9	14	9	34	9	33	81		
82	7	15	7	23	7	31	7	40	7	48	7	56	8	5	8	13	8	21	8	30	82		
83	6	21	6	28	6	35	6	42	6	50	6	57	7	4	7	12	7	19	7	26	83		
84	5	26	5	33	5	39	5	45	5	51	5	58	6	4	6	10	6	17	6	23	84		
85	4	32	4	37	4	42	4	48	4	52	4	55	5	4	5	9	5	14	5	19	85		
86	3	38	3	42	3	46	3	50	3	55	3	59	4	3	4	7	4	11	4	15	86		
87	2	43	2	47	2	50	2	53	2	56	2	59	3	2	3	5	3	9	3	12	87		
88	1	49	1	51	1	53	1	55	1	57	1	59	2	2	2	4	2	6	2	8	88		
89	0	55	0	56	0	57	0	58	0	59	0	59	1	1	1	1	1	3	1	4	89		
90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	90		

T A B L E III.

For reducing the Degrees, Minutes, and Seconds of Longitude, or right Ascension, into Hours, Minutes, and Seconds of Time, and the contrary.

Deg.	H.	M.	Deg.	H.	M.	Degrees.	Hours.
Min.	M.	S.	Min.	M.	S.		
Sec.	S.	T.	Sec.	S.	T.		
1	0	4	31	2	4	70	4 40
2	0	8	32	2	8	80	5 20
3	0	12	33	2	12	90	6 0
4	0	16	34	2	16	100	6 40
5	0	20	35	2	20	110	7 20
6	0	24	36	2	24	120	8 0
7	0	28	37	2	28	130	8 40
8	0	32	38	2	32	140	9 20
9	0	36	39	2	36	150	10 0
10	0	40	40	2	40	160	10 40
11	0	44	41	2	44	170	11 20
12	0	48	42	2	48	180	12 0
13	0	52	43	2	52	190	12 40
14	0	56	44	2	56	200	13 20
15	1	0	45	3	0	210	14 0
16	1	4	46	3	4	220	14 40
17	1	8	47	3	8	230	15 20
18	1	12	48	3	12	240	16 0
19	1	16	49	3	16	250	16 40
20	1	20	50	3	20	260	17 20
21	1	24	51	3	24	270	18 0
22	1	28	52	3	28	280	18 40
23	1	32	53	3	32	290	19 20
24	1	36	54	3	36	300	20 0
25	1	40	55	3	40	310	20 40
26	1	44	56	3	44	320	21 20
27	1	48	57	3	48	330	22 0
28	1	52	58	3	52	340	22 40
29	1	56	59	3	56	350	23 20
30	2	0	60	4	0	360	24 0

The Use of this Table is easy by the Example following: Let it be required to find what Time is required for the Motion of $108^{\circ} 4' 45''$ under the Meridian?

Then against 100° is 6 H. 40' 0"
 8° — 0 32 0
 $4'$ — 0 0 16
 $45''$ — 0 0 3

The Answer is

7 12 19

O HOURS.

M.	S.	$\frac{1}{2}$ Elapl. Time.	Middle Time.	Rising.		M.	S.	$\frac{1}{2}$ Elapl. Time.	Middle Time.	Rising.
0	30	2,66121	2,63982	9,37654	} $\odot$ at	30	30	0,87717	4,42386	2,92656
1	00	2,36018	2,94085	97860		31	00	87015	43088	96067
1	30	2,18409	3,11694	0,33078		31	30	86324	43779	97454
2	00	2,05916	24187	58066		32	00	85644	44459	98820
2	30	1,96225	33878	77448		32	30	84976	45127	3,00164
3	00	88307	41796	93284		33	00	84317	45786	01488
3	30	81613	48490	1,06673		33	30	83669	46434	02792
4	00	75814	54289	18271		34	00	83030	47073	04077
4	30	70700	59403	28502		34	30	82400	47703	05342
5	00	66125	63978	37653		35	00	81780	48323	06590
5	30	1,61986	3,68117	1,45931		35	30	0,81169	4,48934	3,07819
6	00	58208	71895	53488		36	00	80567	49536	09032
6	30	54733	75370	60440		36	30	79973	50130	10227
7	00	51515	78588	66877		37	00	79387	50716	11406
7	30	48520	81583	72869		37	30	78809	51294	12570
8	00	45718	84185	78474		38	00	78239	51864	13718
8	30	43086	87017	83739		38	30	77677	52426	14850
9	00	40605	89498	88703		39	00	77122	52981	15969
9	30	38258	91845	93359		39	30	76574	53529	17072
10	00	36032	94071	97854		40	00	76033	54070	18162
10	30	1,33915	3,96188	2,02091		40	30	0,75499	4,54604	3,19238
11	00	31896	98207	06131		41	00	74972	55131	20301
11	30	29967	4,00136	09991		41	30	74451	55552	21351
12	00	28120	01983	13687		42	00	73937	56166	22389
12	30	26349	03754	17232		42	30	73429	56674	23414
13	00	24647	05456	20638		43	00	72926	57176	24427
13	30	23010	07293	23915		43	30	72430	57673	25428
14	00	21432	08671	27073		44	00	71940	58163	26418
14	30	19910	10193	30120		44	30	71455	58648	27396
15	00	18440	11663	33063		45	00	70976	59127	28363
15	30	1,17018	4,13085	2,35910		45	30	0,70503	4,59600	3,29320
16	00	15642	14461	38667		46	00	70034	60069	30266
16	30	14307	15796	41338		46	30	69571	60532	31202
17	00	13013	17090	43930		47	00	69113	60990	32128
17	30	11757	18346	46447		47	30	68660	61443	33044
18	00	10536	19567	48893		48	00	68212	61891	33950
18	30	09348	20755	51271		48	30	67769	62334	34847
19	00	08193	21910	53586		49	00	67330	62773	35734
19	30	07067	23036	55841		49	30	66806	63207	36613
20	00	05970	24133	58039		50	00	66466	63637	37482
20	30	1,04901	4,25202	2,60182		50	30	0,66041	4,64062	3,38343
21	00	03857	26246	62274		51	00	65620	64483	39195
21	30	02838	27265	64316		51	30	65204	64899	40039
22	00	01843	28260	66312		52	00	64791	65312	40875
22	30	00870	29233	68262		52	30	64383	65720	41702
23	00	0,99918	30185	70170		53	00	63978	66125	42523
23	30	98988	31115	72036		53	30	63578	66525	43334
24	00	98077	32026	73863		54	00	63181	66922	44138
24	30	97184	32919	75652		54	30	62789	67314	44935
25	00	96310	33793	77505		55	00	62400	67703	45724
25	30	0,95454	4,34649	2,79124		55	30	0,62014	4,68089	3,46507
26	00	94614	35489	80809		56	00	61632	68471	47282
26	30	93791	36313	82461		56	30	61254	68849	48058
27	00	92982	37121	84083		57	00	60879	69224	48811
27	30	92189	37914	85675		57	30	60508	69595	49566
28	00	91411	38692	87238		58	00	60140	69963	50314
28	30	90646	39457	88773		58	30	59775	70328	51056
29	00	89894	40209	90282		59	00	59414	70689	51791
29	30	89156	40947	91765		59	30	59056	71047	52520
30	00	88430	41673	93223		60	00	58700	71403	53243

M.	S.	Elapsed Time.	Middle Time.	Rising.	M.	S.	Elapsed Time.	Middle Time.	Rising.
00	30	0, 58348	4, 71755	3, 53959	30	30	0, 41488	4, 88675	3, 88625
01	00	57999	72104	54670	31	00	41261	88242	89097
01	30	57653	72450	55375	31	30	41036	89067	89567
02	00	57310	72793	56074	32	00	40812	89291	90034
02	30	56970	73133	56767	32	30	40590	89513	90498
03	00	56633	73470	57455	33	00	40368	89734	90960
03	30	56298	73805	58137	33	30	40149	89954	91420
04	00	55956	74137	58814	34	00	39930	90173	91876
04	30	55637	74466	59486	34	30	39713	90390	92331
05	00	55311	74792	60152	35	00	39497	90606	92782
05	30	0, 54987	4, 75116	3, 60813	35	30	0, 39282	4, 90821	3, 93232
06	00	54666	75437	61469	36	00	39069	91034	93679
06	30	54347	75756	62120	36	30	38856	91247	94123
07	00	54031	76072	62766	37	00	38646	91457	94566
07	30	53718	76385	63407	37	30	38436	91667	95005
08	00	53406	76697	64043	38	00	38227	91876	95443
08	30	53097	77005	64675	38	30	38020	92083	95878
09	00	52791	77312	65302	39	00	37814	92289	96311
09	30	52487	77616	65924	39	30	37609	92494	96742
10	00	52186	77917	66542	40	00	37405	92698	97170
10	30	0, 51886	4, 78217	3, 67156	40	30	0, 37203	4, 92900	3, 97597
11	00	51585	78514	67765	41	00	37001	93102	98021
11	30	51294	78809	68369	41	30	36801	93302	98443
12	00	51002	79101	68969	42	00	36602	93501	98862
12	30	50711	79392	69566	42	30	36403	93700	99280
13	00	50423	79680	70158	43	00	36206	93897	99696
13	30	50137	79966	70745	43	30	36011	94092	4, 00109
14	00	49852	80251	71329	44	00	35816	94287	00521
14	30	49570	80533	71909	44	30	35622	94481	00930
15	00	49290	80813	72485	45	00	35429	94673	01357
15	30	0, 49012	4, 81091	3, 73057	45	30	0, 35238	4, 94865	4, 01745
16	00	48736	81367	73625	46	00	35047	95056	02146
16	30	48462	81641	74189	46	30	34858	95245	02547
17	00	48189	81914	74750	47	00	34669	95434	02947
17	30	47919	82184	75307	47	30	34482	95621	03344
18	00	47650	82453	75860	48	00	34295	95808	03740
18	30	47384	82719	76409	48	30	34110	95993	04134
19	00	47119	82984	76955	49	00	33925	96178	04526
19	30	46856	83247	77498	49	30	33742	96361	04916
20	00	46595	83508	78037	50	00	33559	96544	05304
20	30	0, 46335	4, 83768	3, 78573	50	30	0, 33378	4, 96725	4, 05650
21	00	46078	84025	79105	51	00	33197	96906	06074
21	30	45822	84281	79634	51	30	33018	97085	06457
22	00	45567	84536	80159	52	00	32839	97264	06838
22	30	45315	84788	80682	52	30	32661	97442	07217
23	00	45064	85039	81201	53	00	32485	97618	07595
23	30	44815	85288	81717	53	30	32309	97794	07970
24	00	44567	85536	82230	54	00	32134	97969	08344
24	30	44321	85782	82739	54	30	31960	98143	08716
25	00	44077	86026	83246	55	00	31787	98316	09087
25	30	0, 43834	3, 86269	3, 83749	55	30	0, 31614	4, 98489	4, 09456
26	00	43592	86511	84250	56	00	31443	98660	09823
26	30	43353	86750	84748	56	30	31272	98831	10188
27	00	43114	86989	85242	57	00	31103	99000	10552
27	30	42878	87225	85734	57	30	30934	99169	10914
28	00	42642	87461	86223	58	00	30766	99337	11275
28	30	42409	87694	86709	58	30	30599	99504	11634
29	00	42176	87927	87192	59	00	30431	99670	11992
29	30	41945	88158	87672	59	30	30268	99835	12348
30	00	41716	88387	88150	60	00	30103	5, 00000	12702

M.	S.	$\frac{1}{2}$ Elapsed Time.	Middle Time.	Rifing.	M.	S.	$\frac{1}{2}$ Elapsed Time.	Middle Time.	Rifing.
00	30	0, 29939	5, 00164	4, 13055	30	30	0, 21432	5, 08671	4, 31801
01	00	29776	00327	13406	31	00	21309	08794	32079
01	30	29614	00489	13756	31	30	21187	08916	32355
02	00	29453	00650	14104	32	00	21066	09037	32631
02	30	29293	00810	14451	32	30	20945	09158	32906
03	00	29133	00970	14797	33	00	20824	09279	33180
03	30	28974	01129	15140	33	30	20704	09399	33452
04	00	28816	01287	15483	34	00	20585	09518	33724
04	30	28659	01444	15824	34	30	20466	09637	33995
05	00	28502	01601	16163	35	00	20348	09755	34265
05	30	0, 28346	5, 01757	4, 16501	35	30	0, 20230	5, 09873	4, 34534
06	00	28191	01912	16838	36	00	20113	09990	34802
06	30	28037	02066	17173	36	30	19996	10107	35069
07	00	27884	02219	17507	37	00	19880	10223	35335
07	30	27731	02372	17839	37	30	19764	10339	35600
08	00	27579	02524	18171	38	00	19648	10454	35865
08	30	27428	02675	18500	38	30	19534	10569	36128
09	00	27277	02826	18829	39	00	19420	10683	36391
09	30	27127	02976	19156	39	30	19306	10797	36652
10	00	26978	03125	19482	40	00	19193	10910	36913
10	30	0, 26830	5, 03273	4, 19806	40	30	0, 19080	5, 11023	4, 37173
11	00	26682	03421	20129	41	00	18968	11135	37432
11	30	26535	03568	20451	41	30	18857	11246	37690
12	00	26389	03714	20771	42	00	18746	11357	37948
12	30	26244	03859	21091	42	30	18635	11468	38204
13	00	26099	04004	21409	43	00	18525	11578	38460
13	30	25955	04148	21725	43	30	18415	11688	38714
14	00	25811	04292	22041	44	00	18306	11797	38968
14	30	25668	04435	22355	44	30	18197	11906	39221
15	00	25526	04577	22668	45	00	18089	12014	39473
15	30	0, 25385	5, 04718	4, 22980	45	30	0, 17981	5, 12122	4, 39724
16	00	25244	04859	23290	46	00	17874	12229	39975
16	30	25104	04999	23599	46	30	17767	12336	40225
17	00	24964	05139	23907	47	00	17660	12443	40474
17	30	24825	05278	24214	47	30	17554	12549	40722
18	00	24687	05416	24520	48	00	17449	12654	40969
18	30	24550	05553	24825	48	30	17344	12759	41215
19	00	24413	05690	25128	49	00	17239	12864	41461
19	30	24277	05826	25430	49	30	17135	12968	41706
20	00	24141	05962	25731	50	00	17031	13071	41950
20	30	0, 24006	5, 06097	4, 26031	50	30	0, 16928	5, 13174	4, 42193
21	00	23871	06232	26330	51	00	16826	13277	42435
21	30	23738	06365	26628	51	30	16724	13379	42677
22	00	23605	06498	26924	52	00	16622	13481	42918
22	30	23472	06631	27220	52	30	16520	13583	43158
23	00	23340	06763	27514	53	00	16419	13684	43398
23	30	23209	06894	27807	53	30	16319	13784	43636
24	00	23078	07025	28099	54	00	16219	13884	43874
24	30	22948	07155	28391	54	30	16119	13984	44111
25	00	22819	07284	28681	55	00	16020	14083	44384
25	30	0, 22690	5, 07413	4, 28969	55	30	0, 15921	5, 14182	4, 44583
26	00	22561	07542	29257	56	00	15823	14280	44818
26	30	22433	07670	29544	56	30	15725	14378	45052
27	00	22306	07797	29830	57	00	15627	14476	45286
27	30	22180	07923	30115	57	30	15530	14573	45518
28	00	22054	08049	30398	58	00	15434	14669	45750
28	30	21928	08175	30681	58	30	15338	14765	45981
29	00	21803	08300	30963	59	00	15242	14861	46212
29	30	21679	08424	31244	59	30	15146	14957	46442
30	00	21555	08548	31523	60	00	15051	15052	46671

M.	S.	$\frac{1}{2}$ Elapsed Time.	Middle Time.	Rising.	M.	S.	$\frac{1}{2}$ Elapsed Time.	Middle Time.	Rising.
00	30	0, 14957	5, 15146	4, 46899	30	30	0, 09981	5, 20122	4, 59436
01	00	14863	15247	47127	31	00	09:09	20194	59627
01	30	14769	15334	47354	31	30	09837	20266	59818
02	00	14676	15427	47280	32	00	09766	20338	60008
02	30	14583	15520	47806	32	30	09694	20409	60198
03	00	14490	15613	48031	33	00	09623	20480	60388
03	30	14398	15705	48255	33	30	09552	20551	60577
04	00	14306	15797	48479	34	00	09482	20621	60765
04	30	14215	15888	48702	34	30	09412	20691	60952
05	00	14124	15979	48924	35	00	09342	20761	61139
05	30	0, 14034	5, 16069	4, 49145	35	30	0, 09273	5, 20830	4, 61326
06	00	13944	16159	49366	36	00	09204	20899	61512
06	30	13854	16249	49586	36	30	09135	20968	61698
07	00	13765	16338	49806	37	00	09067	21036	61883
07	30	13676	16427	50025	37	30	08999	21104	62068
08	00	13587	16516	50243	38	00	08931	21172	62252
08	30	13499	16606	50460	38	30	08864	21239	62436
09	00	13411	16692	50677	39	00	08797	21306	62619
09	30	13324	16779	50893	39	30	08730	21373	62802
10	00	13327	16866	51109	40	00	08664	21440	62984
10	30	0, 13150	5, 16953	4, 51324	40	30	0, 08597	5, 21505	4, 63166
11	00	13064	17039	51539	41	00	08531	21571	63347
11	30	12978	17125	51753	41	30	08466	21637	63528
12	00	12893	17210	51966	42	00	08401	21702	63708
12	30	12808	17295	52178	42	30	08336	21767	63888
13	00	12723	17380	52390	43	00	08271	21832	64067
13	30	12638	17465	52601	43	30	08207	21896	64246
14	00	12554	17549	52812	44	00	08143	21960	64425
14	30	12470	17633	53022	44	30	08079	22025	64603
15	00	12387	17716	53231	45	00	08015	22088	64780
15	30	0, 12304	5, 17799	4, 53440	45	30	0, 07952	5, 22151	4, 64957
16	00	12222	17881	53648	46	00	07889	22214	65134
16	30	12140	17963	53856	46	30	07827	22276	65310
17	00	12058	18045	54063	47	00	07765	22338	65486
17	30	11977	18126	54269	47	30	07703	22400	65661
18	00	11896	18207	54475	48	00	07641	22462	65836
18	30	11815	18288	54680	48	30	07579	22524	66010
19	00	11734	18369	54885	49	00	07518	22585	66184
19	30	11654	18449	55089	49	30	07457	22646	66357
20	00	11574	18529	55293	50	00	07397	22707	66539
20	30	0, 11495	5, 18608	4, 55496	50	30	0, 07337	5, 22766	4, 66702
21	00	11416	18687	55698	51	00	07277	22826	66874
21	30	11337	18766	55900	51	30	07217	22886	67046
22	00	11259	18844	56101	52	00	07158	22945	67217
22	30	11181	18922	56301	52	30	07099	23004	67388
23	00	11104	18999	56501	53	00	07040	23062	67558
23	30	11027	19076	56701	53	30	06981	23123	67728
24	00	10950	19153	56900	54	00	06923	23180	67897
24	30	10873	19230	57098	54	30	06865	23238	68066
25	00	10797	19306	57296	55	00	06808	23295	68235
25	30	0, 10721	5, 19382	4, 57494	55	30	0, 06751	5, 23352	4, 68403
26	00	10645	19458	57690	56	00	06694	23409	68571
26	30	10570	19533	57886	56	30	06637	23466	68738
27	00	10495	19608	58082	57	00	06580	23523	68905
27	30	10421	19682	58277	57	30	06524	23579	69071
28	00	10347	19756	58471	58	00	06468	23635	69237
28	30	10273	19830	58665	58	30	06412	23691	69403
29	00	10199	19904	58859	59	00	06357	23746	69568
29	30	10126	19977	59052	59	30	06302	23801	69733
30	00	10053	20050	59244	60	00	06247	23856	69897

M.	S.	$\frac{1}{2}$ Elapsed Time.	Middle Time.	Rifing.	M.	S.	$\frac{1}{2}$ Elapsed Time.	Middle Time.	Rifing.
00	30	0,06192	5,23911	4,70001	30	30	0,03399	5,26704	4,79193
01	00	06138	23965	70224	31	00	03360	26743	79334
01	30	06084	24019	70387	31	30	03321	26782	79475
02	00	06030	24073	70550	32	00	03283	26820	79616
02	30	05977	24126	70712	32	30	03245	26858	79756
03	00	05924	24179	70874	33	00	03207	26896	79896
03	30	05871	24232	71036	33	30	03170	26934	80036
04	00	05818	24285	71197	34	00	03132	26971	80175
04	30	05766	24337	71352	34	30	03095	27008	80314
05	00	05714	24389	71518	35	00	03058	27045	80452
05	30	0,05662	5,24441	4,71678	35	30	0,03021	5,27082	4,80591
06	00	05610	24493	71837	36	00	02985	27118	80729
06	30	05559	24544	71996	36	30	02949	27154	80867
07	00	05508	24595	72155	37	00	02913	27199	81004
07	30	05457	24646	72313	37	30	02877	27226	81141
08	00	05406	24697	72471	38	00	02841	27262	81278
08	30	05356	24747	72628	38	30	02806	27297	81414
09	00	05306	24797	72786	39	00	02771	27332	81550
09	30	05256	24847	72942	39	30	02736	27367	81686
10	00	05207	24897	73098	40	00	02701	27402	81821
10	30	0,05158	5,24945	4,73254	40	30	0,02667	5,27436	4,81956
11	00	05109	24994	73410	41	00	02633	27470	82091
11	30	05060	25043	73565	41	30	02599	27504	82226
12	00	05012	25091	73720	42	00	02565	27538	82360
12	30	04964	25139	73874	42	30	02532	27571	82494
13	00	04916	25187	74028	43	00	02499	27604	82628
13	30	04868	25235	74182	43	30	02466	27637	82761
14	00	04821	25282	74335	44	00	02433	27670	82894
14	30	04774	25329	74488	44	30	02400	27703	83027
15	00	04727	25376	74641	45	00	02368	27735	83159
15	30	0,04680	5,25423	4,74793	45	30	0,02330	5,27767	4,83291
16	00	04634	25469	74945	46	00	02304	27799	83423
16	30	04588	25515	75096	46	30	02272	27831	83554
17	00	04542	25561	75247	47	00	02241	27862	83685
17	30	04496	25607	75398	47	30	02210	27893	83816
18	00	04451	25652	75549	48	00	02179	27924	83947
18	30	04406	25697	75699	48	30	02148	27955	84077
19	00	04361	25742	75848	49	00	02118	27985	84207
19	30	04316	25787	75997	49	30	02088	28015	84337
20	00	04272	25831	76146	50	00	02058	28045	84466
20	30	0,04228	5,25875	4,76295	50	30	0,02028	5,28075	4,84595
21	00	04184	25919	76443	51	00	01998	28105	84724
21	30	04141	25962	76591	51	30	01969	28134	84853
22	00	04098	26005	76738	52	00	01940	28163	84981
22	30	04055	26048	76885	52	30	01911	28192	85109
23	00	04012	26091	77032	53	00	01882	28221	85236
23	30	03969	26134	77179	53	30	01854	28249	85363
24	00	03927	26176	77325	54	00	01826	28277	85490
24	30	03885	26218	77471	54	30	01798	28305	85617
25	00	03843	26260	77616	55	00	01770	28333	85744
25	30	0,03801	5,26302	4,77761	55	30	0,01743	5,28360	4,85870
26	00	03760	26343	77906	56	00	01716	28387	85996
26	30	03719	26384	78050	56	30	01689	28414	86121
27	00	03678	26425	78194	57	00	01662	28441	86246
27	30	03638	26466	78338	57	30	01635	28468	86371
28	00	03597	26506	78484	58	00	01609	28494	86496
28	30	03557	26546	78624	58	30	01583	28520	86621
29	00	03517	26586	78767	59	00	01557	28546	86745
29	30	03478	26626	78909	59	30	01531	28572	86869
30	00	03438	26665	79051	60	00	01505	28598	86993

M.	S.	$\frac{1}{2}$ Elapsed Time.	Middle Time.	Rising.	M.	S.	$\frac{1}{2}$ Elapsed Time.	Middle Time.	Rising.
00	30	0,01480	5,28623	4,87116	30	30	0,00361	5,29742	4,94033
01	00	01455	28648	87239	31	00	00349	29754	94141
01	30	01430	28673	87362	31	30	00337	29766	94248
02	00	01405	28698	87484	32	00	00325	29778	94356
02	30	01381	28722	87606	32	30	00313	29790	94463
03	00	01357	28746	87728	33	00	00302	29801	94570
03	30	01333	28770	87850	33	30	00291	29812	94676
04	00	01309	28794	87971	34	00	00280	29823	94782
04	30	01286	28817	88092	34	30	00269	29834	94888
05	00	01263	28840	88213	35	00	00259	29844	94994
05	30	0,01240	5,28861	4,88334	35	30	0,00249	5,29854	4,95100
06	00	01217	28886	88454	36	00	00239	29864	95205
06	30	01194	28909	88574	36	30	00229	29874	95310
07	00	01172	28931	88694	37	00	00219	29884	95415
07	30	01150	28953	88814	37	30	00209	29894	95520
08	00	01128	28975	88933	38	00	00200	29904	95624
08	30	01106	28997	89052	38	30	00191	29912	95728
09	00	01084	29019	89171	39	00	00182	29921	95832
09	30	01063	29040	89289	39	30	00174	29929	95936
10	00	01042	29061	89407	40	00	00166	29937	96040
10	30	0,01021	5,29082	4,89525	40	30	0,00155	5,29945	4,96143
11	00	01000	29103	89643	41	00	00150	29953	96246
11	30	00980	29123	89760	41	30	00142	29961	96349
12	00	00960	29143	89877	42	00	00134	29969	96452
12	30	00940	29163	89994	42	30	00127	29976	96554
13	00	00920	29183	90111	43	00	00120	29983	96656
13	30	00900	29203	90227	43	30	00113	29990	96758
14	00	00881	29222	90343	44	00	00106	29997	96860
14	30	00862	29241	90459	44	30	00099	30004	96961
15	00	00843	29260	90575	45	00	00093	30010	97062
15	30	0,00823	5,29279	4,90660	45	30	0,00087	5,30016	4,97163
16	00	00805	29298	90805	46	00	00081	30022	97264
16	30	00787	29316	90920	46	30	00075	30028	97365
17	00	00769	29334	91035	47	00	00070	30033	97465
17	30	00751	29352	91149	47	30	00065	30038	97565
18	00	00733	29370	91263	48	00	00060	30043	97665
18	30	00716	29387	91377	48	30	00055	30048	97765
19	00	00699	29404	91490	49	00	00050	30053	97865
19	30	00682	29421	91603	49	30	00045	30058	97964
20	00	00665	29438	91716	50	00	00041	30062	98063
20	30	0,00648	5,29455	4,91829	50	30	0,00037	5,30066	4,98162
21	00	00632	29471	91942	51	00	00033	30070	98261
21	30	00616	29487	92054	51	30	00029	30074	98359
22	00	00600	29503	92166	52	00	00026	30077	98457
22	30	00584	29519	92278	52	30	00023	30080	98555
23	00	00568	29535	92390	53	00	00020	30083	98653
23	30	00553	29550	92501	53	30	00017	30086	98751
24	00	00538	29565	92612	54	00	00015	30088	98848
24	30	00523	29580	92723	54	30	00012	30090	98945
25	00	00508	29595	92834	55	00	00010	30092	99042
25	30	0,00494	5,29609	4,92944	55	30	0,00008	5,30094	4,99139
26	00	00480	29623	93054	56	00	00007	30096	99236
26	30	00466	29637	93164	56	30	00005	30098	99332
27	00	00452	29651	93274	57	00	00004	30099	99428
27	30	00438	29665	93383	57	30	00003	30100	99524
28	00	00425	29678	93492	58	00	00002	30101	99620
28	30	00412	29691	93601	58	30	00001	30102	99715
29	00	00399	29704	93709	59	00	00000	30103	99810
29	30	00386	29717	93817	59	30	00000	30103	99905
30	00	00373	29730	93925	60	00	00000	30103	5,00000

A TABLE OF NATURAL SINES. 271

0			1		2		3		4		
M.	N. fine	N. col.	N. fine	N. col.	N. fine	N. col.	N. fine	N. col.	N. fine	N. col.	M.
0	00	100000	1745	99985	3490	99939	5234	99863	6970	99756	60
1	29	0000	1774	984	3519	938	5263	861	7005	744	59
2	58	0000	1803	984	3548	937	5292	860	7034	752	58
3	87	0000	1832	983	3577	936	5321	858	7063	750	57
4	116	0000	1862	983	3606	935	5350	857	7092	748	56
5	145	0000	1891	982	3635	934	5379	855	7121	746	55
6	175	0000	1920	982	3664	933	5408	854	7150	744	54
7	204	0000	1949	981	3693	932	5437	852	7179	742	53
8	233	0000	1978	980	3723	931	5466	851	7208	740	52
9	262	0000	2007	980	3752	930	5495	849	7237	738	51
10	291	100000	2036	99979	3781	99929	5524	99847	7266	99736	50
11	320	99999	2065	979	3810	927	5553	846	7295	734	49
12	349	999	2094	978	3839	926	5582	844	7324	731	48
13	378	999	2123	977	3868	925	5611	842	7353	729	47
14	407	999	2152	977	3897	924	5640	841	7382	727	46
15	436	999	2181	976	3926	923	5669	839	7411	725	45
16	465	999	2211	976	3955	922	5698	838	7440	723	44
17	495	999	2240	975	3984	921	5727	836	7469	721	43
18	524	999	2269	974	4013	919	5756	834	7498	719	42
19	553	998	2298	974	4042	918	5785	833	7527	716	41
20	582	99998	2327	99973	4071	99917	5814	99831	7556	99714	40
21	611	998	2356	972	4100	916	5844	829	7585	712	39
22	640	998	2385	972	4129	915	5873	827	7614	710	38
23	669	998	2414	971	4159	914	5902	826	7643	708	37
24	698	998	2443	970	4188	912	5931	824	7672	705	36
25	727	997	2472	969	4217	911	5960	822	7701	703	35
26	756	997	2501	969	4246	910	5989	821	7730	701	34
27	785	997	2530	968	4275	909	6018	819	7759	699	33
28	814	997	2560	967	4304	907	6047	817	7788	696	32
29	844	996	2589	966	4333	906	6076	815	7817	694	31
30	873	99996	2618	99966	4362	99905	6105	99813	7846	99692	30
31	902	996	2647	965	4391	904	6134	812	7875	689	29
32	931	996	2676	964	4420	902	6163	810	7904	687	28
33	960	995	2705	963	4449	901	6192	808	7933	685	27
34	989	995	2734	963	4478	900	6221	806	7962	683	26
35	1018	995	2763	962	4507	898	6250	804	7991	680	25
36	1047	995	2792	961	4536	897	6279	803	8020	678	24
37	1076	994	2821	960	4565	896	6308	801	8049	676	23
38	1105	994	2850	959	4594	894	6337	799	8078	673	22
39	1134	994	2879	959	4623	893	6366	797	8107	671	21
40	1164	99993	2908	99958	4653	99892	6395	99795	8136	99668	20
41	1193	993	2938	957	4682	890	6424	793	8165	666	19
42	1222	993	2967	956	4711	889	6453	792	8194	664	18
43	1251	992	2996	955	4740	888	6482	790	8223	661	17
44	1280	992	3025	954	4769	886	6511	788	8252	659	16
45	1309	991	3054	953	4798	885	6540	786	8281	657	15
46	1338	991	3083	952	4827	883	6569	784	8310	654	14
47	1367	991	3112	952	4856	882	6598	782	8339	652	13
48	1396	990	3141	951	4885	881	6627	780	8368	649	12
49	1425	990	3170	950	4914	879	6656	778	8397	647	11
50	1454	99989	3199	99949	4943	99878	6685	99776	8426	99644	10
51	1483	989	3228	948	4972	876	6714	774	8455	642	9
52	1513	989	3257	947	5001	875	6743	772	8484	639	8
53	1542	988	3286	946	5030	873	6773	770	8513	637	7
54	1571	988	3316	945	5059	872	6802	768	8542	635	6
55	1600	987	3345	944	5088	870	6831	766	8571	632	5
56	1629	987	3374	943	5117	869	6860	764	8600	630	4
57	1658	986	3403	942	5146	867	6889	762	8629	627	3
58	1687	986	3432	941	5175	866	6918	760	8658	625	2
59	1716	985	3461	940	5205	864	6947	758	8687	622	1
	N. col.	N. Sine	N. col.	N. fine	N. col.	N. fine	N. col.	N. fine	N. col.	N. fine	
	89		88		87		86		85		

M.	5		6		7		8		9		M.
	N. fine	N. col.	N. fine	N. col.	N. fine	N. col.	N. fine	N. col.	N. fine	N. col.	
0	8716	99619	10453	99452	12187	99255	13917	99027	15643	98769	60
1	8745	617	482	449	216	251	946	023	672	764	59
2	8774	614	511	446	245	248	975	019	701	760	58
3	8803	612	540	443	274	244	14004	015	730	755	57
4	8831	609	569	440	302	240	033	011	758	751	56
5	8860	607	597	437	331	237	061	006	787	746	55
6	8889	604	626	434	360	233	090	002	816	741	54
7	8918	602	655	431	389	230	119	98998	845	737	53
8	8947	599	684	428	418	226	148	994	873	732	52
9	8976	596	713	424	447	222	177	990	902	728	51
10	9005	99594	10742	99421	12476	99219	14205	98986	15931	98723	50
11	9034	591	771	418	504	215	234	982	959	718	49
12	9063	588	800	415	533	211	263	978	988	714	48
13	9092	586	829	412	562	208	292	973	16017	709	47
14	9121	583	858	409	591	204	320	969	036	704	46
15	9150	580	887	406	620	200	349	965	074	700	45
16	9179	578	916	402	649	197	378	961	103	695	44
17	9208	575	945	399	678	193	407	957	132	690	43
18	9237	572	973	396	706	189	436	953	160	686	42
19	9266	570	11002	393	735	186	464	948	189	681	41
20	9295	99567	11031	99390	12764	99182	14493	98944	16218	98676	40
21	9324	564	060	386	793	178	522	940	246	671	39
22	9353	562	089	383	822	175	551	936	275	667	38
23	9382	559	118	380	851	171	580	931	304	662	37
24	9411	556	147	377	880	167	608	927	333	657	36
25	9440	553	176	374	908	163	637	923	361	652	35
26	9469	551	205	370	937	160	666	919	390	648	34
27	9498	548	234	367	966	156	695	914	419	643	33
28	9527	545	263	364	995	152	723	910	447	638	32
29	9556	542	291	360	13024	148	752	906	476	633	31
30	9585	99540	11320	94357	13053	99144	14781	98902	16505	98626	30
31	9614	537	349	354	081	141	810	897	533	624	29
32	9642	534	378	351	110	137	838	893	562	619	28
33	9671	531	407	347	139	133	867	889	591	614	27
34	9700	528	436	344	168	129	896	884	620	609	26
35	9729	526	465	341	197	125	925	880	648	604	25
36	9758	523	494	337	226	122	954	875	677	600	24
37	9787	520	523	334	254	118	982	871	706	595	23
38	9816	517	552	331	283	114	15011	867	734	590	22
39	9845	514	580	327	312	110	040	863	763	585	21
40	9874	99511	11609	99324	13341	99106	15069	98858	16792	98580	20
41	9903	508	638	320	370	102	097	854	820	575	19
42	9932	506	667	317	399	098	126	849	849	570	18
43	9961	503	696	314	427	094	155	845	878	565	17
44	9990	500	725	310	456	091	184	841	906	561	16
45	10019	497	754	307	485	087	212	836	935	556	15
46	10048	494	783	303	514	083	241	832	964	551	14
47	10077	491	812	300	543	079	270	827	992	546	13
48	10106	488	840	297	572	075	299	823	17021	541	12
49	10135	485	869	293	600	071	327	818	050	536	11
50	10164	99482	11898	99290	13629	99067	15356	98814	17078	98531	10
51	10192	479	927	286	658	063	355	809	107	526	9
52	10221	476	956	283	687	059	414	805	136	521	8
53	10250	473	985	279	716	055	442	800	164	516	7
54	10279	470	12014	276	744	051	471	796	193	511	6
55	10308	467	043	272	773	047	500	791	222	506	5
56	10337	464	071	269	802	043	529	787	250	501	4
57	10366	461	100	265	831	039	557	782	279	496	3
58	10395	458	129	262	860	035	586	778	308	491	2
59	10424	455	158	258	880	031	615	773	336	486	1
	N. col.	N. fine	N. col.	N. fine	N. col.	N. fine	N. col.	N. fine	N. col.	N. fine	
	84		83		82		81		80		

A TABLE OF NATURAL SINES. 173

	10		11		12		13		14		
M.	N. fine	N. col.	N. fine	N. col.	N. fine	N. col.	N. fine	N. col.	N. fine	N. col.	M.
0	17365	98481	19081	98163	20791	97815	22495	97437	24192	97030	60
1	393	476	109	157	820	809	523	430	220	023	56
2	422	471	138	152	848	803	552	424	249	015	58
3	451	466	167	146	877	797	580	417	277	008	57
4	479	460	195	140	905	790	608	411	305	001	56
5	508	455	224	135	933	784	637	404	333	96994	55
6	537	450	252	129	962	778	665	398	361	987	54
7	565	445	281	124	990	772	693	391	390	980	53
8	594	440	309	118	21019	766	722	384	418	973	52
9	623	435	338	112	047	760	750	378	446	966	51
10	17651	98430	19366	98107	21076	97754	22778	97371	24474	96959	50
11	680	425	395	101	104	748	807	365	503	952	49
12	708	420	423	096	132	742	835	358	531	945	48
13	737	414	452	090	161	735	863	351	559	937	47
14	766	409	480	084	189	729	892	345	587	930	46
15	794	404	509	079	218	723	920	338	615	923	45
16	823	399	538	073	246	717	948	331	644	916	44
17	852	394	566	067	275	711	977	325	672	909	43
18	880	388	595	061	303	705	23005	318	700	902	42
19	909	383	623	056	331	698	033	311	728	894	41
20	17937	98378	19652	98050	21360	97692	23062	97304	24756	96887	40
21	966	373	680	044	388	686	090	298	784	880	39
22	995	368	709	039	417	680	118	291	813	873	38
23	18023	362	737	033	445	673	146	284	841	866	37
24	052	357	766	027	474	667	175	278	869	858	36
25	081	352	794	021	502	661	203	271	897	851	35
26	109	347	823	016	530	655	231	264	925	844	34
27	138	341	851	010	559	648	260	257	953	837	33
28	166	336	880	004	587	642	288	251	982	829	32
29	195	331	908	97998	616	636	316	244	25010	822	31
30	18224	98325	19937	97992	21644	97630	23345	97237	25038	96815	30
31	252	320	965	987	672	623	373	230	066	807	29
32	281	315	994	981	701	617	401	223	094	800	28
33	309	310	20022	975	729	611	429	217	122	793	27
34	338	304	051	969	758	604	458	210	151	786	26
35	367	299	079	963	786	598	486	203	179	778	25
36	395	294	108	958	814	592	514	196	207	771	24
37	424	288	136	952	843	585	542	189	235	764	23
38	452	283	165	946	871	579	571	182	263	756	22
39	482	277	193	940	899	573	599	176	291	749	21
40	18509	98272	20222	97934	21928	97566	23627	97169	25320	96742	20
41	538	267	250	928	956	560	656	162	348	734	19
42	567	261	279	922	985	553	684	155	376	727	18
43	595	256	307	916	22013	547	712	148	404	719	17
44	624	250	336	910	041	541	740	141	432	712	16
45	652	245	364	905	070	534	769	134	460	705	15
46	681	240	393	899	098	528	797	137	488	697	14
47	710	234	421	893	126	521	825	120	516	690	13
48	738	229	450	887	155	515	853	113	545	682	12
49	767	223	478	881	183	508	882	106	573	675	11
50	18795	98218	20507	97875	22212	97502	23910	97100	25601	96667	10
51	824	212	535	869	240	496	938	093	629	660	9
52	852	207	563	863	268	489	966	086	657	653	8
53	881	201	592	857	297	483	995	079	685	645	7
54	910	196	620	851	325	476	24023	072	713	638	6
55	938	190	649	845	353	470	051	065	741	630	5
56	967	185	677	839	382	463	079	058	769	623	4
57	995	179	706	833	410	457	108	051	798	615	3
58	19024	174	734	827	438	450	136	044	826	608	2
59	052	168	763	821	467	444	164	037	854	600	1
	N. col.	N. fine	N. col.	N. col.	.col.	N. fine	N. col.	N. fine	N. col.	N. fine	
	79		78		77		76		75		

	15		16		17		18		19		
M.	N. fine	N. col.	N. fine	N. col.	N. fine	N. col.	N. fine	N. col.	N. fine	N. col.	M.
0	25832	96553	27564	96126	29237	95630	30902	95106	32557	94552	60
1	910	585	592	118	265	622	929	097	584	542	59
2	938	578	620	110	293	613	937	088	612	533	58
3	566	570	648	102	321	605	985	079	639	523	57
4	994	562	676	094	348	596	31012	070	667	514	56
5	26022	555	704	086	376	588	040	061	694	504	55
6	050	547	732	078	404	579	063	052	722	495	54
7	079	540	759	070	432	571	095	043	749	485	53
8	107	532	787	062	460	562	123	033	777	476	52
9	135	524	815	054	487	554	151	024	804	466	51
10	26163	96517	27843	96046	29515	95545	31178	95015	32832	94457	50
11	191	509	871	037	543	536	206	006	859	447	49
12	219	502	899	029	571	528	233	94997	887	438	48
13	247	494	927	021	599	519	261	988	914	428	47
14	275	486	955	013	626	511	289	979	942	418	46
15	303	479	983	005	654	502	316	970	969	409	45
16	331	471	28011	95997	682	493	344	961	997	399	44
17	359	463	039	989	710	485	372	952	33024	390	43
18	387	456	067	981	737	476	399	943	051	380	42
19	415	448	095	972	765	467	427	933	079	370	41
20	26443	96440	28123	95964	29793	95459	31454	94924	33106	94361	40
21	471	433	150	956	821	450	482	915	134	351	39
22	500	425	178	948	849	441	510	906	161	342	38
23	528	417	206	940	876	433	537	897	189	332	37
24	556	410	234	931	904	424	565	888	216	322	36
25	584	402	262	923	932	415	592	878	244	313	35
26	612	394	290	915	960	407	620	869	271	303	34
27	640	386	318	907	987	398	648	860	298	293	33
28	668	379	346	898	30015	389	675	851	326	284	32
29	696	371	374	890	043	380	703	842	353	274	31
30	26724	96363	28402	95882	30071	95372	31730	94832	33381	94264	30
31	752	355	429	874	098	363	758	823	408	254	29
32	780	347	457	865	126	354	786	814	436	245	28
33	808	340	485	857	154	345	813	805	463	235	27
34	836	332	513	849	182	337	841	795	490	225	26
35	864	324	541	841	209	328	868	786	518	216	25
36	892	316	569	832	237	319	896	777	545	206	24
37	920	308	597	824	265	310	923	768	573	196	23
38	948	301	625	816	292	301	951	758	600	186	22
39	976	293	652	807	320	293	979	749	627	176	21
40	27004	96285	28680	95739	30348	95284	32006	94740	33655	94167	20
41	032	277	708	791	376	275	034	730	682	157	19
42	060	269	736	782	403	266	061	721	710	147	18
43	088	261	764	774	431	257	089	712	737	137	17
44	116	253	792	766	459	248	116	702	764	127	16
45	144	246	820	757	486	240	144	693	792	118	15
46	172	238	847	749	514	231	171	684	819	108	14
47	200	230	875	740	542	222	199	674	846	098	13
48	228	222	903	732	570	213	227	665	874	088	12
49	256	214	931	724	597	204	254	656	901	078	11
50	27284	96206	28959	95715	30625	95195	32282	94646	33929	94068	10
51	312	198	937	707	653	186	309	637	956	058	9
52	340	190	29015	698	680	177	337	627	983	049	8
53	368	182	042	690	708	168	364	618	34011	039	7
54	396	174	070	681	736	159	392	609	038	029	6
55	424	166	098	673	763	150	419	599	065	019	5
56	452	158	126	664	791	142	447	590	093	009	4
57	480	150	154	656	819	133	474	580	120	93099	3
58	508	142	182	647	846	124	502	571	147	980	2
59	536	134	209	639	874	115	529	561	175	970	1
	N. col.	N. fine	N. col.	N. fine	N. col.	N. fine	N. col.	N. fine	N. col.	N. fine	
	74		73		72		71		70		

A TABLE OF NATURAL SINES.

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20			21		22		23		24		
M.	N. line	N. col.	N. line	N. col.	N. line	N. col.	N. line	N. col.	N. line	N. col.	M.
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1	229	959	864	348	488	707	100	039	700	343	59
2	257	949	891	337	515	797	127	028	727	331	58
3	284	939	918	327	542	686	153	016	753	319	57
4	311	929	945	316	569	675	180	005	780	307	56
5	339	919	973	306	595	664	207	91994	806	295	55
6	366	909	36000	295	622	653	234	982	833	283	54
7	393	869	027	285	649	642	260	971	860	272	53
8	421	889	054	274	676	631	287	959	880	260	52
9	448	879	081	264	703	620	314	948	913	248	51
10	34475	93869	36108	93253	37730	92609	39341	91936	40939	91236	50
11	503	859	135	243	757	598	367	925	966	224	49
12	530	849	162	232	784	587	394	914	992	212	48
13	557	839	190	222	811	576	421	902	41019	200	47
14	584	829	217	211	838	565	448	891	045	188	46
15	612	819	244	201	865	554	474	879	072	176	45
16	639	809	271	190	892	543	501	868	098	164	44
17	666	799	298	180	919	532	528	856	125	152	43
18	694	789	325	169	946	521	555	845	151	140	42
19	721	779	352	159	973	510	581	833	178	128	41
20	34748	93769	36379	93148	37999	92499	39608	91822	41204	91116	40
21	775	759	406	137	38026	488	635	810	231	104	39
22	803	748	433	127	053	477	661	799	257	092	38
23	830	738	461	116	080	466	688	787	284	080	37
24	857	728	488	106	107	455	715	775	310	068	36
25	884	718	515	095	134	444	741	764	337	056	35
26	912	708	542	084	161	432	768	752	363	044	34
27	939	698	569	074	188	421	795	741	390	032	33
28	966	688	596	063	215	410	822	729	416	020	32
29	993	677	623	052	241	399	848	718	443	008	31
30	35021	93667	36650	93042	38268	92388	39875	91706	41469	90996	30
31	048	657	677	031	295	377	902	694	496	984	29
32	075	647	704	020	322	366	928	683	522	972	28
33	102	637	731	010	349	355	955	671	549	960	27
34	130	626	758	92999	376	343	982	660	575	948	26
35	157	616	785	988	403	332	40008	648	602	936	25
36	184	606	812	978	430	321	035	636	628	924	24
37	211	596	839	967	456	310	062	625	655	911	23
38	239	585	867	956	483	299	088	613	681	899	22
39	266	575	894	945	510	287	115	601	707	887	21
40	35293	93565	36921	92935	38537	92276	40141	91590	41734	90875	20
41	320	555	948	924	564	265	168	578	760	863	19
42	347	544	975	913	591	254	195	566	787	851	18
43	375	534	37002	902	617	243	221	555	813	839	17
44	402	524	029	892	644	231	248	543	840	826	16
45	429	514	056	881	671	220	275	531	866	814	15
46	456	503	083	870	698	209	301	519	892	802	14
47	483	493	110	859	725	198	328	508	919	790	13
48	511	483	137	849	752	186	355	496	945	778	12
49	538	472	164	838	778	175	381	484	972	766	11
50	35565	93462	37191	92827	38805	92164	40408	91472	41998	90753	10
51	592	452	218	816	832	152	434	461	42024	741	9
52	619	441	245	805	859	141	461	449	051	729	8
53	647	431	272	794	886	130	488	437	077	717	7
54	674	420	299	784	912	119	514	425	104	704	6
55	701	410	326	773	939	107	541	414	130	692	5
56	728	400	353	762	966	096	567	402	156	680	4
57	755	389	380	751	993	085	594	390	183	668	3
58	782	379	407	740	39020	073	621	378	209	655	2
59	810	368	434	729	046	062	647	366	235	643	1
	N. col.	N. line	N. col.	N. line	N. col.	N. line	N. col.	N. line	N. col.	N. line	
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2	315	606	889	854	451	074	999	267	532	434	58
3	341	594	916	841	477	061	47024	254	557	420	57
4	367	582	942	828	503	048	050	240	583	405	56
5	394	569	968	816	529	035	076	226	608	391	55
6	420	557	994	803	554	021	101	213	634	377	54
7	446	545	44020	790	580	008	127	199	659	363	53
8	473	532	046	777	606	995	153	185	684	349	52
9	499	520	072	764	632	981	178	172	710	335	51
10	42525	90507	44098	89752	45658	89968	47204	88158	48735	87321	50
11	552	495	124	739	684	955	229	144	761	306	49
12	578	483	151	726	710	942	255	130	786	292	48
13	604	470	177	713	736	928	281	117	811	278	47
14	631	458	203	700	762	915	306	103	837	264	46
15	657	446	229	687	787	902	332	089	862	250	45
16	683	433	255	674	813	88888	358	075	888	235	44
17	709	421	281	662	839	875	383	062	913	221	43
18	736	408	307	649	865	862	409	048	938	207	42
19	762	396	333	636	891	848	434	034	964	193	41
20	42708	90383	44359	89623	45917	88855	47460	88020	48989	87178	40
21	815	371	385	610	942	822	486	006	49014	164	39
22	841	358	411	597	968	808	511	87993	040	150	38
23	867	346	437	584	994	795	537	979	065	136	37
24	894	334	464	571	46020	782	562	985	090	121	36
25	920	321	490	558	046	768	588	951	116	107	35
26	946	309	516	545	072	755	614	937	141	093	34
27	972	296	542	532	097	741	639	923	166	079	33
28	999	284	568	519	123	728	665	909	192	064	32
29	43025	271	594	506	149	715	690	896	217	050	31
30	43051	90259	44620	89493	46175	88701	47716	87882	49242	87036	30
31	077	246	646	480	201	688	741	868	268	021	29
32	104	233	672	467	226	674	767	853	293	007	28
33	130	221	698	454	252	661	793	840	318	86993	27
34	156	208	724	441	278	647	818	826	344	978	26
35	182	196	750	428	304	634	844	812	369	964	25
36	209	183	776	415	330	620	869	798	394	949	24
37	235	171	802	402	355	607	895	784	419	935	23
38	261	158	828	389	381	593	920	770	445	921	21
39	287	146	854	376	407	580	946	756	470	906	21
40	43313	90133	44880	89363	46433	88566	47972	87743	49495	86802	20
41	340	120	906	350	458	555	997	729	521	878	19
42	366	108	932	337	484	539	48022	715	546	863	18
43	392	095	958	324	510	526	048	701	571	849	17
44	418	082	984	311	536	512	073	687	596	834	16
45	445	070	45010	298	561	499	099	673	622	820	15
46	471	057	036	285	587	485	124	659	647	805	14
47	497	045	062	272	613	472	150	645	672	791	13
48	523	032	088	259	639	458	175	631	697	777	12
49	549	019	114	245	664	445	201	617	723	762	11
50	45375	90007	45140	89232	46600	88431	48226	87603	49748	86748	10
51	602	89994	106	219	716	417	252	589	773	733	9
52	628	931	192	206	742	404	277	575	798	719	8
53	654	968	218	193	767	390	303	560	824	704	7
54	680	956	243	180	793	377	328	546	849	690	6
55	706	943	269	167	819	363	354	532	874	675	5
56	732	930	295	153	844	349	379	518	899	661	4
57	758	918	321	140	870	336	405	504	924	646	3
58	785	905	347	127	896	322	430	490	950	632	2
59	811	892	373	114	921	308	456	476	975	617	1
	N.col.	N.line	N.col.	N.line	N.col.	N.line	N.col.	N.line	N.col.	N.line	
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M.	N.fine	N.col.	N.fine	N.co	N.fine	N.col.	N.fine	N.col.	N.fine	N.col.	M.
0	50000	86603	51504	85717	52992	84805	54464	83867	55919	82904	60
1	025	588	529	702	53017	789	488	851	943	887	59
2	050	573	554	687	041	774	513	835	968	871	58
3	076	559	579	672	066	759	537	819	992	855	57
4	101	544	604	657	091	743	561	804	56016	839	56
5	126	530	628	642	115	728	586	788	040	822	55
6	151	515	653	627	140	712	610	772	064	806	54
7	176	501	678	612	164	697	635	756	088	790	53
8	201	486	703	597	189	681	659	740	112	773	52
9	227	471	728	582	214	666	683	724	136	757	51
10	50252	86457	51753	85567	53238	84650	54708	83708	56160	82741	50
11	277	442	778	551	263	635	732	692	184	724	49
12	302	427	803	536	288	619	756	676	208	708	48
13	327	413	828	521	312	604	781	660	232	692	47
14	352	398	852	506	337	588	805	645	256	675	46
15	377	384	877	491	361	573	829	629	280	659	45
16	403	369	902	476	386	557	854	613	305	643	44
17	428	354	927	461	411	542	878	597	329	626	43
18	453	340	952	446	435	526	902	581	353	610	42
19	478	325	977	431	460	511	927	565	377	593	41
20	50503	86319	52002	85416	53484	84495	54951	83549	56401	82577	40
21	528	295	026	401	509	480	975	533	425	561	39
22	553	281	051	385	534	464	999	517	449	544	38
23	578	266	076	370	558	448	55024	501	473	528	37
24	603	251	101	355	583	433	048	485	497	511	36
25	628	237	126	340	607	417	072	469	521	495	35
26	654	222	151	325	632	402	097	453	545	478	34
27	679	207	175	310	656	386	121	437	569	462	33
28	704	192	200	294	681	370	145	421	593	446	32
29	729	178	225	279	705	355	169	405	617	429	31
30	50754	86163	52250	85264	53730	84339	55194	83389	56641	82413	30
31	779	148	275	249	754	324	218	373	665	396	29
32	804	133	299	234	779	308	242	356	689	380	28
33	829	119	324	218	804	292	266	340	713	363	27
34	854	104	349	203	828	277	291	324	736	347	26
35	879	089	374	188	853	261	315	308	760	330	25
36	904	074	398	173	877	245	339	292	784	314	24
37	929	059	423	157	902	230	363	276	808	297	23
38	954	045	448	142	926	214	388	260	832	281	22
39	979	030	473	127	951	198	412	244	856	264	21
40	51004	86015	52498	85112	53975	84182	55436	83228	56880	82248	20
41	029	000	522	096	54000	167	460	212	904	231	19
42	054	85985	547	081	024	151	484	195	928	214	18
43	079	970	572	066	049	135	509	179	952	198	17
44	104	956	597	051	073	120	533	163	976	181	16
45	129	941	621	035	097	104	557	147	57000	165	15
46	154	926	646	020	122	088	581	131	024	148	14
47	179	911	671	005	146	073	605	115	047	132	13
48	204	896	696	84989	171	057	630	098	071	115	12
49	229	881	720	974	195	041	654	082	095	098	11
50	51254	85866	52745	84959	54220	84025	55678	83066	57119	82082	10
51	279	851	770	943	244	009	702	050	143	065	9
52	304	836	794	928	269	83994	726	034	167	048	8
53	329	821	819	913	293	978	750	017	191	032	7
54	354	806	844	897	317	962	775	001	215	015	6
55	379	792	869	882	342	946	799	82985	238	81999	5
56	404	777	893	866	366	930	823	969	262	982	4
57	429	762	918	851	391	915	847	953	286	995	3
58	454	747	943	836	415	899	871	936	310	949	2
59	479	732	967	820	439	883	895	920	334	932	1
	N.col.	N.fine	N.col.	N.fine	N.col.	N.fine	N.col.	N.fine	N.col.	N.fine	
	59		58		57		56		55		

	35		36		37		38		39		
M.	N. fine	N. col.	N. fine	N. col.	N. fine	N. col.	N. fine	N. col.	N. fine	N. col.	M.
0	57358	81915	58779	80402	60181	79864	61566	78801	62932	77715	60
1	381	899	802	885	205	846	589	783	955	696	59
2	405	882	826	867	228	829	612	765	977	678	58
3	429	865	849	850	251	811	635	747	63000	660	57
4	453	848	873	833	274	793	658	729	022	641	56
5	477	832	896	816	298	776	681	711	045	623	55
6	501	815	920	799	321	758	704	693	068	605	54
7	524	798	943	782	344	741	726	676	090	586	53
8	548	781	967	765	367	723	749	658	113	568	52
9	572	765	990	748	390	706	772	640	135	550	51
10	57596	81748	59014	80700	60414	79688	61795	78622	63158	77531	50
11	619	731	037	713	437	671	818	604	180	513	49
12	643	714	061	696	460	653	841	586	203	494	48
13	667	698	084	679	483	635	864	568	225	476	47
14	691	681	107	662	506	618	887	550	248	458	46
15	715	664	131	644	529	600	909	532	271	439	45
16	738	647	154	627	553	583	932	514	293	421	44
17	762	631	178	610	576	565	955	496	316	402	43
18	786	614	201	593	599	547	978	478	338	384	42
19	809	597	225	576	622	530	62001	460	361	366	41
20	57833	81580	59248	80558	60645	79335	62251	78442	63383	77347	40
21	857	563	272	541	668	424	046	424	406	329	39
22	881	540	295	524	691	477	069	405	428	310	38
23	904	530	318	507	714	459	092	387	451	292	37
24	929	513	342	489	738	441	115	369	473	273	36
25	952	496	365	472	761	424	138	351	496	255	35
26	976	479	389	455	784	406	160	333	513	236	34
27	999	462	412	438	807	388	183	315	540	218	33
28	58023	445	435	420	830	371	206	297	563	199	32
29	047	428	459	403	853	353	229	279	585	181	31
30	58070	81412	59482	80385	60876	79335	62251	78261	63608	77162	30
31	094	395	506	368	899	318	274	243	630	144	29
32	118	378	529	351	922	300	297	225	653	125	28
33	141	361	552	334	945	282	320	206	675	107	27
34	165	344	576	316	968	264	342	188	698	088	26
35	189	327	599	299	991	247	365	170	720	070	25
36	212	310	622	282	61015	229	388	152	742	051	24
37	236	293	646	264	038	211	411	134	765	033	23
38	260	276	669	247	061	193	433	116	788	014	22
39	283	259	693	230	084	176	456	098	810	76956	21
40	58307	81242	59716	80212	61107	79158	62479	78079	63852	76977	20
41	330	225	739	195	130	140	502	061	854	959	19
42	354	208	763	178	153	122	524	043	877	940	18
43	378	191	786	160	176	105	547	025	899	921	17
44	401	174	809	143	199	087	570	007	922	903	16
45	425	157	832	125	222	069	592	77988	944	884	15
46	449	140	856	108	245	051	615	970	966	866	14
47	472	123	879	091	268	033	638	952	989	847	13
48	496	106	902	073	291	015	660	934	64011	828	12
49	519	089	926	056	314	78998	683	916	033	810	11
50	58543	81072	59949	80038	61337	78980	62706	77897	64056	76791	10
51	567	055	972	021	360	962	728	879	078	772	9
52	590	038	995	003	383	944	751	861	100	754	8
53	614	021	60019	79986	406	926	774	843	123	735	7
54	637	004	042	968	429	908	796	824	145	717	6
55	661	80987	065	951	451	891	819	806	167	698	5
56	684	970	089	934	474	873	842	788	190	679	4
57	708	953	112	916	497	855	864	769	212	661	3
58	731	936	135	899	520	837	887	751	234	642	2
59	755	910	158	881	543	819	909	733	256	623	1
	N. col.	N. fine	N. col.	N. fine	N. col.	N. fine	N. col.	N. fine	N. col.	N. fine	
	54		53		52		51		50		

A TABLE OF NATURAL SINES.

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	40		41		42		43		44		
M.	N.fine	N.co.	N.fine	N.co.	N.fine	N.co.	N.fine	N.co.	N.fine	N.co.	M.
0	64279	76604	65606	75471	66913	74314	68200	73135	69466	71934	60
1	301	586	628	452	935	295	221	116	487	914	59
2	323	567	650	433	956	276	242	096	508	894	58
3	346	548	672	414	978	256	264	076	529	873	57
4	368	530	694	395	999	237	285	056	549	853	56
5	390	511	716	375	67021	217	306	036	570	833	55
6	412	492	738	356	043	198	327	016	591	813	54
7	435	473	759	337	064	178	349	72996	612	792	53
8	457	455	781	318	086	159	370	976	633	772	52
9	479	436	803	299	107	139	391	957	654	752	51
10	64501	76417	65825	75280	67129	74120	68412	72937	69675	71732	50
11	524	398	847	261	151	100	433	917	696	711	49
12	546	380	869	241	172	080	455	897	717	691	48
13	568	361	891	222	194	061	476	877	737	671	47
14	590	342	913	203	215	041	497	857	758	650	46
15	612	323	935	184	237	022	518	837	779	630	45
16	635	304	956	165	258	002	539	817	800	610	44
17	657	286	978	146	280	73983	561	797	821	590	43
18	679	267	66000	126	301	963	582	777	842	569	42
19	701	248	022	107	323	944	603	757	862	549	41
20	64723	76229	66044	75088	67344	73924	68624	72737	69883	71529	40
21	746	210	066	069	366	904	645	717	904	508	39
22	768	192	088	050	387	885	666	697	925	488	38
23	790	173	109	030	409	865	688	677	946	468	37
24	812	154	131	011	430	846	709	657	966	447	36
25	834	135	153	74992	452	826	730	637	987	427	35
26	856	116	175	973	473	806	751	617	70008	407	34
27	878	097	197	953	495	787	772	597	029	386	33
28	901	078	218	934	516	767	793	577	049	366	32
29	923	059	240	915	538	747	814	557	070	345	31
30	64945	76041	66262	74896	67559	73728	68835	72537	70091	71325	30
31	967	022	284	876	580	708	857	517	112	305	29
32	989	003	306	858	602	688	878	497	132	284	28
33	65011	75984	327	838	623	669	899	477	153	264	27
34	033	965	349	818	645	649	920	457	174	243	26
35	055	946	371	799	666	629	941	437	195	223	25
36	077	927	393	780	688	610	962	417	215	203	24
37	099	908	414	760	709	590	983	397	236	182	23
38	122	889	436	741	730	570	69004	377	257	162	22
39	144	870	458	722	752	551	025	357	277	141	21
40	65166	75851	66480	74703	67773	73531	69046	72337	70298	71121	20
41	188	832	501	683	795	511	067	317	319	100	19
42	210	813	523	664	816	491	088	297	339	080	18
43	232	794	545	644	837	472	109	277	360	059	17
44	254	775	566	625	859	452	130	257	381	039	16
45	276	756	588	606	880	432	151	236	401	019	15
46	298	738	610	586	901	412	172	216	422	70998	14
47	320	719	632	567	923	393	193	196	443	978	13
48	342	699	653	548	944	373	214	176	463	957	12
49	364	680	675	528	965	353	235	156	484	937	11
50	65386	75661	66697	74509	67987	73333	69256	72136	70505	70916	10
51	408	642	718	489	68008	314	277	116	525	896	9
52	430	623	740	470	029	294	298	095	546	875	8
53	452	604	762	451	051	274	319	075	567	855	7
54	474	585	783	431	072	254	340	055	587	834	6
55	496	566	805	412	093	234	361	035	608	813	5
56	518	547	827	392	115	215	382	015	628	793	4
57	540	528	848	373	136	195	403	71995	649	772	3
58	562	509	870	353	157	175	424	974	670	752	2
59	583	490	891	334	179	155	445	954	690	731	1
	N.co.	N.fine	N.co.	N.fine	N.co.	N.fine	N.co.	N.fine	N.co.	N.fine	
	49		48		47		46		45		

SOUTH COAST of England, bounding the British Channel, and the opposite Coast of France. With the Latitudes, and Longitudes, and Time of High Water; and the Time the Current runs in the Offing of some Places.

English Coast.	H.W.	Lat.	Long.	French Coast.	H.W.	Lat.	Long.
H.M.	D.M.	D.M.	D.M.	H.M.	D.M.	D.M.	D.M.
North Foreland	10 30	51 25 N.	1 34 E.	Dunkirk —	12 0	51 2 N.	2 27 E.
Ramsgate —	10 30	51 20	1 30	Graveline —	11 45	51 0	2 12
Deal —	10 30	51 14	1 30	Calais —	11 30	50 57	1 56
The Downs —	10 30	51 25	1 40	Boulogne —	10 30	50 43	1 42
South Foreland	10 30	51 12	1 32	Abbeville —	10 30	50 7	1 56
Dover —	10 30	51 7	1 22	Dieppe —	10 30	49 57	1 9
Rye —	11 15	51 3	0 50	Havre de Grace	9 0	49 30	0 17
Dengeneys —	9 45	50 57	1 6	Rouen up R. Syne	1 15	49 27	1 10
Hastings —	11 0	50 52	0 84	Sine R. Mouth	9 0	49 36	0 30
Beachyhead —	11 0	50 48	0 24	Caen —	9 0	49 11	0 16 W
Brightelmstone	10 0	50 50	0 0	C. Barfleur —	7 30	49 38	1 16
Arundel —	9 0	50 50	0 24 W	Cherbourg —	9 0	49 38	1 34
Shorcham —	9 45	50 51	0 17	C. de la Hague	12 0	49 42	1 45
Chichester —	11 0	49 52	0 43	Coutances —	6 0	49 2	1 27
Portsmouth —	11 15	50 48 ¹ / ₂	1 4	Granville —	6 0	48 50	1 36
Southampton	12 0	50 55	1 22	Auranches —	6 0	48 41	1 24
Spithead Road	11 15	50 48	1 6	St. Malo —	6 0	48 39	1 57
Cows, I. of Wight	11 30	50 48	1 16	Seven Islands —		48 53	3 30
St. Helen's Road	10 30	50 43	0 55	Isle de Bas —	3 45	48 50	4 0
Bembridge. I. Wi.	10 15	50 40	0 52	Bay of BISCAY.			
Dunnoe —	9 45	50 35	1 7	Brest —	3 45	48 23	4 26 W
Catharine's Point	9 0	50 34	1 14	Port Louis —	3	47 48	3 20
Needles 10h. 15m	8 15	50 42	1 34	<i>The East Coast of Britain and Places up Rivers.</i>			
Christ Church	8 15	50 46	1 44				
Pool Dorsetshire	6 45	50 46	1 54	H.W.	D.M.	D.M.	
Peveral Point	8 45	50 36	1 50	R. Thames, Lond	3 0	51 32	0 0 E.
St. Alban's Head	8 30	50 28	2 0	Gravesend	1 30	51 28	0 20
Weymouth —	7 30	50 38	2 30	R. Medway,			
Bill of Portland	6 30	50 31	2 30	Rocheſter &	0 45	51 25	0 36
Exmouth Bar	5 45	50 42	3 35	Chatham }			
Exeter —	0 0	50 45	3 39	Sheerneſs	12 0	51 31	0 50
Torbay —	5 15	50 34	3 38	The Nore	12 0	51 34	1 6
Dartmouth —	5 15	50 27	3 36	Margate	11 0	51 25	1 20
Start Point —	6 45	50 9	3 45	King's Channel	10 30	51 38	1 16
Prall, S. P. of Dev.	0 0	50 5	5 50	along the			
Plymouth —	6 0	50 21	4 20	Swin Runs }	12		
Eddiſtone Tide ru	8 15	50 7	4 23	Kentish Knock			
Ram Head	7 30	50 16	3 56	the Eaſter-			
Falmouth —	7 30	50 10	5 12	moſt Sand in			
Lizard Point	7 30	49 57	5 14	the King's	10 30	51 37	1 40
Mount's Bay —	4 30	50 5	5 45	Channel, N.			
Land's End —	7 30	50 6	6 0	of the Downs }			
Scilly I. —	3 45	50 6	6 49	the Cur. run ſtill	1 0	0 0	0 0
St. Marie's I.	3 45	49 58	6 40	Harwich 10h 30m	11 15	51 58	1 20
Aldern. & Caskets	12 0	49 48	2 10	Ipfwich 11	11	52 8	1 10
Guern. I. & Sark I.	1 30	49 30	2 47				
Jerſey I. —	1 30	49 7	2 26				

Note, H.W. ſtands for High Water; R. for River; I. for Iſland; P. for Point; and C. for Cape.
The Longitude is reckoned from the Meridian of London.

				<i>West Coast of England.</i>				
	H. M.	D. M.	D. M.		H. W.	La. N.	Long. W.	
					H. M.	D. M.	D. M.	
Sole Bay —	9	30	52 24	1 50 E.	White Haven —	10 45	54 35	3 44
Leftoff to —	9	0	52 36	1 52	St. Bee's-head	10 45	54 30	3 45
ower Lights —	8	0	52 48	1 44	Lancaster —	11 0	53 42	3 6
Wintertonnes Li.			52 50		Chester or W.			
Orforenes —	9	45	52 10	1 20	Chester R. }	11 30	53 12	3 11
Yarmouth —	9	30	52 45	1 50	Dec			
Ditto Road —	8	15			Parkgate —	11 0	53 17	3 15
Cromer Lights	7	30	53 3	1 14	Liverpool,	11 0	53 22	3 18
Vells —	6	15	53 4	1 0	Holyhead —	11 30	53 23	4 40
Lynn, in Norfolk	6	0	52 50	0 22	Barley or Bardslyl	3 30	52 44	4 50
Boston —	6	0	53 10	0 12	St. David's-head	6 0	51 55	5 10
Mo. of R. }					St. Bide's Bay	5 0	51 56	5 0
Humber the }	5	15	53 30	0 16	Gresholm Isle —	5 30	51 50	5 15
Spurn					Milford Haven	5 15	51 45	5 0
R. Hamber, Hull	6	0	53 45	0 12 W	Swansea —	6 0	51 40	3 50
Birdlington Bay	3	45	54 6	0 0	Mouth of the }			
Flamboroughhead	3	0	54 10	0 5 E.	Severn, Fla-	6 0	51 22	3 10
Scarborough —	3	45	54 18	0 12 W	tholme's Isle }			
Robin-hood Bay	3	45	54 22	0 17	Bristol —	6 45	51 26	2 45
Whitby —	3	0	54 30	0 22	Lundy Island	5 15	51 20	4 44
R. Lee's Mouth	3	0	54 40	1 0	Hartland Point	4 30	51 8	4 30
Stockton —	5	15	54 27	1 10	C. Cornwall sh. 30	7 0	50 10	5 50
Hartlepool —	3	0	54 45	1 0	Land's End 5 30	7 30	50 6	5 52
Sunderland —	3	0	54 56	1 10				
North Shields —	3	0	55 2	1 12				
Newcastle —	5	15	55 2	1 26				
Tinmouth Castle	3	0	55 4	1 12				
Sunderland Point	3	0	55 32	1 24				
Holy Island —	2	45	55 40	1 34				
Berwick —	2	30	55 46	1 42				
St. Abb's Head	2	0	55 54	1 50				
Dunbar —	2	3	55 58	2 18				
Edinburg —	4	30	55 58	3 0				
Buckanefs —	3	0	57 30	1 35				
Aberdeen —	0	45	57 7	1 52				
Cathneps Point,	9	0	58 46	3 17				

of Orkney and Shetland.

Pickland Skeries	3	0	58 54 N	3 0 W
Pomona chief Isle	3	0	59 24	3 20
North Ronaldsa,				
the Northern- }	3	0	59 46	2 45
most of the ne.				
S H E T L A N D Isles				
Fair Isle —	3		59 30	2 20
Foule Isle —	3		60 12	2 40
Sella Isle —	3		60 35	2 24
Balta Isle —	3		60 31	1 4
Sears Isle —	3		60 15	1 0

West Coast of Scotland.

Cape Wrath	0	30	58 40 N	4 50 W
Isle of Lewis —			58 30	6 30
I. of Sky, N. —			57 45	6 35
Douglas I. of Man	10	30	54 10	4 24

<i>West Coast of England.</i>			
	H. W. La. N.	Long. W.	
	H. M.	D. M.	D. M.
White Haven —	10 45	54 35	3 44
St. Bee's-head	10 45	54 30	3 45
Lancaster —	11 0	53 42	3 6
Chester or W.			
Chester R. }	11 30	53 12	3 11
Dec			
Parkgate —	11 0	53 17	3 15
Liverpool,	11 0	53 22	3 18
Holyhead —	11 30	53 23	4 40
Barley or Bardslyl	3 30	52 44	4 50
St. David's-head	6 0	51 55	5 10
St. Bide's Bay	5 0	51 56	5 0
Gresholm Isle —	5 30	51 50	5 15
Milford Haven	5 15	51 45	5 0
Swansea —	6 0	51 40	3 50
Mouth of the }			
Severn, Fla-	6 0	51 22	3 10
tholme's Isle }			
Bristol —	6 45	51 26	2 45
Lundy Island	5 15	51 20	4 44
Hartland Point	4 30	51 8	4 30
C. Cornwall sh. 30	7 0	50 10	5 50
Land's End 5 30	7 30	50 6	5 52

The Coast of Ireland.

Dublin —	10 30	53 12	7 3
Wexford —	9 45	52 13	7 33
Waterford —	7 30	52 7	7 52
Cork, the Cove	5 16	51 40	9 30
Kinsale —	6 0	51 32	9 44
Lupis's Head	6 0	52 24	10 15
Cape Clear —	5 45	51 18	9 50
Messen Head		51 16	10 10
Limerick —	6 0	52 22	9 48
Galway —	6 30	53 10	10 3
Sline Head —	7 0	53 20	11 15
Broad Haven	7 0	54 7	10 6
Londonderry	7 30	55 1	7 31
Fair Foreland	0 0	55 10	6 35
Belfast, Lough	4 15	54 43	5 52
Lambay Island	8 15	53 24	7 30
Tory Island —	5 30	55 9	8 32
Isle of Aran	11 0	54 48	8 59
Carlingford Bay		54 0	6 10

The West Coast of France.

Isle of Ushant	6 0	48 30 N.	4 55 W
B est —	3 15	48 23	4 26
Penmark Point	3 0	47 50	4 20
Bell Isle —	3 30	47 21	3 13
Angers —	0 0	47 28	0 34
Rochelle —	3 45	46 10	1 11
Nantz —	0 0	47 13	1 30
Bordeaux —	3 0	44 50	0 30
Bayone —	3 30	43 29	1 25

West Coast of Spain and Portugal.

	H.W.	Lat.	Long.
	H.M.	D.M.	D.M.
Cape Ortegal	3 0	43 52	7 58W
Cape Pinas	3 0	43 11	6 6
C. Corunna,	3 0	43 28	8 15
C. Prior	0 0	43 38	8 5
C. Finistère	3 15	43 3	9 6
Ville del Conde		41 19	8 20
Oporto, or Porta Port P }	0 0	41 5	8 6
Bayonna	4 45	42 3	8 45
Burlings		39 36	9 10
Lisbon	2 45	38 42	8 53
C. Roxent	1 0	38 40	9 16
C. St. Vincent		36 58	8 45
Cadiz 5	4 30	36 33	5 56
Cape Trefalgar		36 10	5 55
Gibraltar	12 0	36 12	4 53

The Coasts on the Main Continent within the Straits.

Places Names.	Lat.	Long.
	D.M.	D.M.
Malaga	36 42 N	4 0 W
Cape de Gat	36 40	1 40
Cape Paul	38 15	0 1 E.
Alicant	38 35	0 15
Cape St. Martin	38 46	0 30
Barcelona	41 26	2 18
Marseilles	43 18	5 27
Toulon	43 7	6 2
Genoa	44 25	8 40
Leghorn	43 28	10 30
Civita Vecchia	42 10	11 15
Rome	41 54	12 25
Naples	40 51	14 20
Cape Spartevento	37 55	16 45
Cape Colonne	38 56	18 1
Gallipoli	40 20	18 23
Cape St. Maria, or Lucia	39 45	19 0
Ancona	43 40	13 30
Venetia, or Venice	45 25	12 10
Zara	44 30	16 35
Ragusa	42 45	18 50
Cattaro	42 47	19 17
La Valona	40 55	21 15
Lepanto	38 20	22 42
Cape Matapan, or Caliga	36 33	22 41
Cape St. Angelo, or Angulo	36 32	23 56
Athens	37 58	24 5
Cape Martello South Point of Negropont	38 7	25 3
Cape Colom, or Colonne	37 45	24 42
Salonica	40 41	23 13

Places Names.	Lat.	Long.
	D.M.	D.M.
Cape Monte Sancto	40 26 N	25 2 E.
Gallipoli	40 33	27 20
Constantinople	40 59	28 56
Cape Barbador, or Baba	39 30	26 30
Smyrna	38 28	27 25
Cape Barbernola, or Blane	38 9	26 32
Ephesus	38 1	27 53
Antiochetta	36 30	32 46
Standaroon, or Alexan- dretta	36 34	36 30
Antiocha	36 11	37 18
Aleppo	35 42	37 24
Tortosa	35 40	36 0
Tripoli	34 48	36 5
Joppa or Jaffa	32 45	36 0
Jerusalem	31 51	35 25
Alexandria	31 10	30 19
Cape Rufata	32 48	21 25
Cape Mesurata	32 21	16 17
Tripoly	32 54	13 10
Sufa	35 53	10 34
Cape Bona	37 3	11 4
Tunis	36 50	10 17
Bona	36 52	8 19
Seven Capes	37 15	7 0
Gigeri	37 14	6 15
Cape Tidelles, or Dellys	37 15	4 18
Algier	36 50	2 19
Cape Tenes	36 45	1 50
Orain	36 2	26
Cape Trées Forcas	35 30	2 4 W
Ceuta	35 54	4 45
Tangier	35 52	5 45

Islands within the Straits.

	Lat.	Long.
	D.M.	D.M.
Alboram	36 0 N	2 27 E.
Formentaria	38 33	1 15
Ivica	38 50	1 39
Majorca	39 45	3 0
Minorca	39 51	4 0
C. Tolare, So. { End of }	38 50	9 12
C. Reperaden { Sardin }	41 10	9 50
Afinaria	41 3	8 48
Bonifacio, So. { End of }	41 24	9 46
C. Corfo, Nor. { Corfic }	42 56	9 50
Capri, or Captia	43 3	10 17
Liboa, or Elba,	42 45	10 40
Panoza	41 0	13 3
M. Crifto	42 17	11 0
Palmarolla, or Palmeria	41 3	13 5
Ponza	41 0	13 7
Ischia, or Eschia	40 54	13 35
Lissa	43 6	16 40
Agosta	42 58	17 20
Corzola	43 3	17 32

Places Names.		Lat. D.M.	Long. D.M.	<i>Coast of Iceland.</i>		Lat. D.M.	Long. D.M.
Strombello		38 58 N	16 E.	Sound Royal		66 22	14 30 W
Vulcano		38 27	15 33	Bargazar Point		66 20	16 32
Pellicur		38 30	15 0	Whale's back		65 26	20 32
Allicur		38 30	14 42	Merchant's Forel.		63 24	17 5
Africa		38 36	13 32	Halliford		64 30	27 20
Trepano W. End of	Sicily	37 57	13 13	Fair Foreland		66 18	26 30
Palermo in		38 6	13 50	Grim's Island		67 13	22 32
L. Paffaro E. End of		36 38	15 40	Westmonia Isles		63 28	22 22
Messina in		38 7	16 20	Isles of Ferre, or			
Syracuse in		37 3	15 45	Farro		62 4	5 0
Pantalasia		36 48	12 30	Beerenburg, or			
Limosa		35 56	13 11	Joan Main Isle.		71 30	4 30
Lampidofa		35 34	12 46				
Malta		35 53	14 32				
Ouvre Poel, a Rock		55 45	16 36				
Melada		42 52	13 6				
Corfu		39 42	19 46				
Cephalonia		38 15	20 10				
Zante		37 46	21 14				
Sapienza		36 40	21 45				
<i>Islands in the Archipelago.</i>				<i>Coast of Greenland.</i>			
Tafio		40 40 N	25 17 E.	Point Look-out	Var.	76 24	15 33 E
Lemnos		39 59	25 37	Horn-sound	West	76 45	13 34
Metyline { Cape Sygre		39 15	26 5	Bell-sound		77 12	12 45
{ P. Olivia		38 57	27 0	Charles I. Black			
Siato, or Schate		39 22	23 58	Point		77 35	11 15
Scio, or Xio		38 22	26 12	C. Cold N. end			
Patmos		37 20	26 55	Charles I.	13 36	79 6	11 2
Tino		37 35	25 36	Isle Amsterdam		79 40	12 45
Zio, or Sea		37 37	24 50	Fair Foreland		79 18	10 50
Ferminid, Fermina, or				Hacluit's Head-			
Termie		37 24	24 58	land	17 40	79 47	10 46
Serfante, or Sifanto		36 58	25 20	Cloven Cliff	18 24	79 43	9 56
Milo		36 40	25 0	Muffin Isle	18 13	80 19	11 20
W. } End of	Candia	Cape St John	35 15	Black Point	9 42	78 28	18 38
E. }		Cape Solom.	35 0	Table I. one of			
Rhodes { N. End of Cape		36 27	28 38	the 7	9 33	80 57	20 34
{ S End Tranquil		36 1	28 28	Smcerenburg	18 53	79 44	11 48
SW. } End of	Cypus	C. Baffa	34 57	Dunkins Isle in	18 47	79 42	9 59
East }		C. St Andr.	35 31	Vogel Sound	20 38	79 52	12 30
Sout }		C. de Gatte	34 30	Hope Island		76 15	23 40
				Cherry, or Bear Isle		74 28	18 0
				Admiralty Isle		75 0	54 40
				Nova Sembla		78 0	70 0
				Weigate Straits		70 30	60 0
				Cape Candinose		69 0	42 33
				Cat Nose		65 40	35 0
				Archangel		64 34	38 6
				Cross Island		66 30	36 30
				Sweetnose		68 6	34 40
				Kilduyn		69 24	31 20
				North Cape		71 27	27 30
				Surroy		71 0	20 0
				Tromsund		70 20	15 26
				Læfort S.W. Point		68 10	9 28
				Dronthem		63 26	11 4
				Statland		62 12	4 40
				North Bergen		60 10	6 14
				Naze of Norway	12 0	57 44	7 20
<i>Coast of Greenland.</i>							
Nova Zem. & Isles	H.W.						
Shetland So. Point	H.M.						
North ditto	3 0	59 56 N	1 30 W				
Hangcliff	Var.	60 50	0 10				
Entr. of Brasy Sou.	23 45	60 9	0 38				

Coast in the Sound and Baltic.

	Var.	Lat.	Long.
	West	D.M.	D.M.
Mardou		58 20 N	8 58 E.
Christiana		59 23	9 50
Gottenburg		57 50	12 10
Elfinore	10	56 23	12 40
Copenhagen		55 40	12 50
Kalmer		56 40	16 30
Stockholm		59 20	18 10
Vybourg		60 50	29 12
Petersburg	0 00	59 56	30 22
Narva		59 26	28 20
Revel		59 24	24 50
Riga		57 0	25 10
Derwinda		57 12	22 0
Koningsberg		54 40	21 30
Dantzic		54 22	18 36
Visby in Gothland		57 30	18 25
Bornholm		55 12	14 40
Strael Sound		54 24	13 10
Lubec		54 4	11 40
Anout		56 50	11 0
Le fou		57 4	10 27

Coast of Holland and Flanders.

	H.W.	57 30	10 20 E.
Low		54 25	8 33
Helighland		53 30	9 0
Bremen	6 0	53 30	9 0
Hamburgh	6 15	53 40	10 30
Embsen	12 15	53 3	7 30
The Fly	6	43 12	5 30
The Texel	6 30	53 12	5 10
Amsterdam	3	52 22	5 15
Rotterdam	3 45	51 57	4 34
Antwerp		51 13	4 28
The Brill	1 30	52	4 7
Offend	12	51 14	3 1

Western Islands, or Azores.

	P	39 48 N	31 20 W
Corvo		39 24	30 20
Flores		38 40	27 0
Sial		39 0	24 50
Tercera		38 45	25 56
St. George's		38 36	26 20
Pico, or Pic of Azores		38 12	22 50
St. Michael's		37 0	22 56
St. Marie's			

Canary Islands.

	Lat.	Long.
	D.M.	D.M.
1. Porto Sanfco	33 6 N	16 5 W
2. Madeira P East end	32 50	16 26
Funchal	32 32	17 6
Ditto West and	32 30	17 28
3. Palma	28 40	17 35
4. Teneriff, the Pic	28 25	16 25
5. Gemara	27 57	17 7
6. Ferro, or Isle of Fer	27 48	17 33
7. Canaria	27 53	15 38
8. I. Fortune Ventura	28 20	14 10
Seven others N. E. of this.		

Cape de Verd Islands.

	17 0 N	24 25 W
1. St. Anthony	16 55	24 10
2. St. Vincent	16 53	24 0
3. St. Lucia	16 40	23 22
4. St. Nicholas	16 57	21 52
5. I. of Sel	16 5	21 45
6. Bonavista	15 14	22 5
7. Isle of May	15 0	22 45
8. Isle of St. Jaga	14 50	23 22
9. Isle of St. Philip	14 45	24 10
10. Isle of St. Jean		

Coast of Barbary and Guinea.

	35 45 N	5 48 W
Cape Spartel	34 0	6 20
Sallee	32 48	8 50
Cape Cantin	30 40	10 5
Cape de Gear	28 15	11 6
Cape de Nun	26 28	14 22
Cape Bajadore	23 28	15 50
Cape Olerado	22 6	16 43
Cape das Barbas	20 46	17 20
Cape Blanco	19 12	15 30
Cape Mirick	15 36	16 20
Mouth of Senegal River	16 36	12 40
Senegal	14 42	17 5
Cape de Verd	13 20	15 0
Mouth of River Gambia	12 12	16 18
Cape Roguè	8 30	12 12
Mouth of River Sierralion	6 28	9 30
Cape Monferado	4 25	6 0
Cape Palmas		

Coast of Barbary and Guinea.

	Lat. D.M.	Long. D.M.
Cape Three Points	4 45 N	3 10 W
River Voltas	5 50	1 10 E.
River Formosa	6 10	4 50
New Callabar	5 0	7 0
Old Calabar	4 30	8 10
River Cammaroos	3 30	9 10
River Angra	1 0	9 35
Cape Lopez	0 48 S.	8 30
River Congo	5 45	11 50
Angola	8 15	15 0
Cape Negro	16 30	11 30
Cape St. Thomas	24 54	15 25
The Cape Town	33 56	18 23
Cape of Good Hope	34 30	18 45
Cape False, or Hanglip	34 34	19 15

Southern Islands in the Atlantic.

St. Mathews	1 23 S.	6 10 W
Ascension	7 57	13 54
St. Helena	16 4	5 54
Fernandepo	3 2 N	3 32 E.
Princes	1 48	6 40
St. Thomas	0 0	7 0
Cape Podron	6 0 S.	11 40
Annabona	2 26	5 40
St. Philips	12 22	13 20

Tristão de Cunha	37 10 S.	13 20 W
Ile de Picos	24 0	16 20
I. Martinvas	21 0	18 40
I. St. Maria	20 0	18 40
I. Trinidad	20 30	25 30
I. Ascension	20 40	28 30
I. Fernando Noronha	3 50	30 35
I. Rocas	5 0	35 40
I. Sealdes	50 53	50 35

A Table of the Latitude, Longitude, Variation, where there

Lat. d.	Lon. d.	Vari. d. m.	variation, where there has been no change or mutation of the Variation for many years.
0	40 W	3 30 E.	
5 N	5	13 0 W	
5	30	1 30 W	
5	35	30 E.	
5	40	2 15	
5	45	4 0	
10 N	50	4 0	
15	60	5 0	
20	70	5 0	
25	65	2 15	
30	84	0 0	

And by observations of several commanders of ships who have sailed in Hudson's Bay, about lat. 60 deg. N. and lon. 65 deg. W. their compasses have whirled about in a strange manner, by which it may be supposed, that they were affected by the magnetic matter in that part of the Bay.

NORTH AMERICA

	Lat. D.M.	Long. D.M.
Sir T. Smith's Sound	78 30 N	63 30 W
Digg's or Dudley's Cape	76 50	59 00
Hackluit Island	77 25	59 30
Alde man Jones's Sound	77 30	59 00
James Lancaster's Sound	74 10	50 00
Baffin's-bay James's Isle	71 40	57 30
Baffin's Straits, Cumb. I.	68 00	62 30

Hudson's-Bay Islands.

I. of Good Fortune	65 00 N	67 30 W
King Charles's Cape	65 00	77 30
At the Mouth of Hudson's Straits.		
I. of Resolution	61 40	64 30 W
Chidley I.	60 40	63 30
Strait	I. of Salisbury	63 30
	I. of Nottingham	63 30
	I. of Southampton	63 30
	I. of Mansel	62 00
Repulse Bay	67 56	84 40
Cape Dobbs	65 35	84 45
Bowden's Inlet	64 30	94 00
Marble Island	63 00	91 45
Prince of Wales's Fort		
Churchill River	58 48	94 12
York Fort, Nelson Riv*	57 36	93 10
Cape Tatnam	58 00	91 00
Cape Henrietta	55 22	83 00

Coast of New-Britain.

Cape Britton, West End	60 20 N	64 30 W
of the I. of Button		
Cardinal's Isles	58 50	61 40
St. Peter's Haven	56 36	59 50
Gantin Bay	57 10	61 30

Coast of Hudson's Bay & Straits.

Cape Farewell	59 40 N	44 30 W
Q. Ann's Foreland	64 6	74 40
Shark Point	64 10	82 15
Cape Southampton	61 55	86 20
Cape Churchill	59	95 30
The Cubbs	54 16	82 35
Albany River	52 36	85 20
Charlton I.	52 3	80 5
Rupert's River	51 40	78 50
Cape Jones	55 10	79 0
Mansfield's Isle	61 45	80 30
Cape Walsingham	62 40	78 0
Cape Charles	62 46	74 15

* Nelson R. runs from Winnipeg lake (Lat. 49 deg. N Lon. 102 W.) from which lake there is a large river which runs to the Pacific Ocean, and joins it in Lat. 44 deg. 30m. N. Lon. 130 deg. W.

*Coast of Carolina, Virginia,
Maryland, Pennsylvania, New-
England, and Newfoundland.*

	Lat. D.M.	Long. D.M.
Cape Roy	47 40 N	57 0
lacentia	47 38	52 0
Cape St. Mary	46 54	52 20
Cape Race	46 50	51 0
Cape Confo	45 17	6 3
ouifbourg	45 54	59 55
t. John's Harbour	43 0	50 15
t. John's Fort	47 32	52 43
Conception Bay	48 24	50 20
Trinity Bay Entrance	48 54	50 30
Cape Bonavita	49 34	50 20
Cape St. John	50 24	52 45
ell Island	51 50	51 30
ay of Breft	52 10	52 40
Cape Blanco	47 20	70 0
Quebec	48 47	71 15
Cape Breton	46 3	58 0
traits of Monfac, Nova		
Scotia	45 39	61 20
le Sable	44 15	59 0
Cape Sable	43 44	65 25
allifax	44 32	63 20
oston	42 25	70 32
Cape Cod	42 14	69 0
New York	40 43	74 4
ong Island	41 0	73 0
Cape May	39 15	74 45
Cape Charles	37 12	76 0
Cape Henry	37 0	76 23
Cape Hatteras	35 10	76 0
Philadelphia Town	40 10	75 4
Cape Lookout	34 25	77 0
Cape Fear	33 49	78 0
Charles Town on Ashley		
River	33 21	79 48
ort Royal So. Carolina	32 20	80 25
ay of St. Augustine	29 52	80 34
Cape Canival Reefs	28 16	80 45
ey Largo	25 0	81 43
Cape Florida	25 7	81 25
ry Tortugas, Southern	24 33	
— Northernmost	24 38	85 10
ey Market, W. Key,		
S. end	24 36	84 24
nt. of Spir. Sancto Har-		
bour in E. Florida		
(var. 5d. 45m. E.)	27 40	83 49
Cape Blaze	29 41	86 25
. Joseph's Point	29 55	85 28
Entrance of St. Andrew's		
Bay	30 8	86 45

	Lat. D.M.	Long. D.M.
The Cliffs 2 miles W. of it*		
Cape St. George	29 37 N	86 7 W
Penfacola Town	30 29	88 22
Penfacola Bar	30 19	88 25 1/2

Coast of Carolina, &c.

Rose Island West end	30 20 N	88 5 W
Entrance of Mobile Riv	30 10	87 37
Dauphin Island	29 41	87 54
Ship Island Bay	30 30	88 20
New Orleans	29 58	89 55
Entrance of the Mississipi	29 10	89 32
Candlemas Isles or Chan-		
dineers the N. part		
of the Northernmost	30 2	89 6
Jucosa Bay	29 18	94 15
Bay of St. Bernard	28 15	95 45
Port Blanche in the Isle		
of Labos	21 48	97 16
Mexico City	20 0	100 35
La Vera Cruz	19 5	98 30

Campeche Bay.

Point St. Martin	18 30 N	96 00 W
Tabasco Isle, N. Point	18 00	92 36
Bay of Port Sumacenta	17 50	91 45
River Lagarto's Mouth	21 15	88 15
Musketo Shore from C.		
Catoche to Cape 3	17 39	87 00
Points in the Gulph	16 06	89 36
of Honduras		
Cape Bafar, Ascen. Bay	17 39	88 30
Cape Honduras	16 06	85 34
Coast of Honduras		
Cape Comaron	16 04	84 00
Santa Morfac	10 57	83 12
C. Gracios a Deos var.		
11 d. 16m. E	15 04	82 00
Porto Bello* (var. 9d.		
45m. E)	9 33	78 52

* There is a large square grove, at the foot of which is a low red bank, 4 leagues W. of St. Andrew's Bay, and 12 Leagues East of Rose Island.

† The Isthmus of Darien which joins N. and S. America, is 70 miles wide from Panama to Porto Bello.

Bahama Islands.

	Lat. D.M.	Long. D.M.
N. part Bahama Bank	27 45 N	79 40 W
Bahama Island ———	26 42	79 10
Abacco, South Point	26 15	78 50
Harbour Island ———	25 20	77 37
Andrass, North Point	25 00	79 40
Providence ———	24 50	78 08
Illathera, South Point	24 55	76 45
Cat Island, South Point	24 00	76 00
Rum Key ———	23 00	74 20
Exuma ———	23 25	75 34
Crooked Isl. N. Point	22 46	73 50
Akin's Key ———	22 06	73 45
Merapavouz River	22 00	74 10
Atwood's Key ———	21 22	72 40
French Key ———	22 30	73 40
Hoghties ———	21 40	73 15
Heneago ———	21 07	73 00
Caico's Bank, N. Point,	21 50	71 50
Turk's Island ———	21 45	70 30
Abrholho, North Point	21 34	69 40
Plate Wrack River	20 04	68 40

Caribbee Islands.

Anguilla ———	18 15 N	60 00 W
St. Martin's ———	18 05	62 30
St. Bartholomew's	17 52	62 35
Barbuda ———	18 05	61 35
St. Christopher's ———	17 15	62 50
Nevis ———	16 55	62 40
Antigua ———	16 56	61 50
Monferat ———	16 36	62 12
Guardalupe ———	16 20	61 25
Marigallalte ———	16 0	61 0
Dominico ———	15 15	61 10
Martinico ———	14 44	60 57
St. Lucia ———	13 45	61 10
St. Vincent ———	13 10	61 0
Barbadoes, Bridge-To.	13 5	59 45
Willoughby Fort ———		
Granada ———	11 52	61 40
Trinidad ———	10 38	60 30
Virgin Gorda Fort ———	18 18	63 50
Virgin's I. ———	18 28	64 40
St. Cruz ———	17 55	65 0
Bieque ———	18 0	65 30
Porto Rico ———		
St. John's ———	18 30 N	67 10 W

*The Latitudes and Longitudes
of Places in the WEST
INDIES, as determined
by Capt. Barnaby, Com-
mander of the Zephyr Sloop
of War, in the Years 1771,
1772, and 1773, by CELES-
TIAL OBSERVATIONS.*

	Lat. D.M.	Long. D.M.
Bridge Town, Barbadoes	13 8 N	59 50 W
North Part of ditto	13 34	60 0
Tobago N. E. Part	11 21	60 15
Curassö, E. end ———	12 12	61 30
Sugarloaf Hill in the Isle of Auruba (var. 8 deg. 5 min. E.)	12 33	70 0
Bermuda S. Point (var. 4 deg. 30 min. W.)	34 14	64 45
San Domingo ———	18 25	69 20
Altavella ———	17 28	71 8
Cape Francis, Hispaniola	19 59	71 35
Sam Bay do.	18 4	71 55
Port au Prince (var. 8 deg. E)	18 38	72 15
Port Piment, Hispaniola	18 8	73 41
Plat Form, do.	19 36	72 58
Isle of Ash, S. W. part	18 4	73 8
Port Louis Hispaniola	18 19	73 0
N. E. End of Jamaica	18 25	75 49
Easternmost part of ditto	18 2	75 40
Port Royal, ditto. (var. 6 deg. 30 min. E.)	17 53	76 36
Morant Keys, ditto	17 29	75 27
S. E. part of Port Morant	17 54	76 2
Formagos ———	18 24	76 30
Cape Mays, E. end of Cuba ———	20 15	74 50
Cape Antony, W. End of ditto ———	21 50	85 0
Cape Catoche Jucaton, New Spain ———	21 34	87 0
Havanna in the I of Cu- ba, (var. 4 deg. E)	23 12	81 41
St. Jago, ———	20 3	75 51
Isle of Pines, S. W. Point ———	21 32	82 45
Pine's Bay, (var. 6 deg. 24 min. E. ———)	21 44	83 30

Observations by Capt. Barnaby, &c.

	Lat. D.M.	Long. D.M.
lowland in I. of Pines* which is due S. from the middlemost of the three high Hummocks	21 29 N	83 30 W
Middle high Hummock	21 46	83 30
Point Irois	18 28	74 17
Isle of Navafa	18 26	74 36
Cape Donna Maria	18 45	74 14
Cape Tiberoon	18 22	74 7
Point Dabacou	19 57	73 10
Mole Head	19 47	73 11
Cape Nicholas	19 43	73 10
Gonave, S. Point of		
W. part	18 51	72 33
of Tatuga, } N.E. part	20 10	71 59
or Tartudas } W. part	20 12	72 23
Mayaguana, E. end	22 29	72 30
Watling I. North part	24 10	76 0
Key Sal	23 45	80 43

SOUTH AMERICA.

Carthagena (var. 8 de E)	10 26 N	75 25 W
Cape Aguia	11 32	73 10
St. Martha	11 22	74 00
Cape de la Velle	12 18	71 45
Arcuba	12 45	69 52
Curacoa	12 12	69 06
Blanche	12 15	64 15
Coast of Comana C. 3 P	11 15	62 44
Dragon Entrance	11 10	62 15
Gulph of Paria, Trinity		
I. or Trinidad	10 30	61 30
Mouth of River Orinoco	8 30	60 30

Coast of Guiana.

Surinam	6 00 N	55 50 W
Ceyenne	4 56	52 10
Cape Orange	4 10	51 05
North Cape	1 40	50 10
Mouth of R. Amazons	0 40	48 10

Coast of Wild Brazil.

Island St. Juan	1 20 S	45 00 W
Mouth of River Omara	5 00	34 55

* Which is the Southermost Part of the
Isle of Pines.

*Coast of Brazil, Paragua, and
Patagonia.*

	Lat. D.M.	Long. D.M.
I. Ferdinando Loronho	3 48 S	30 50 W
Cape Roque	5 00	35 45
Cape St. Augustine	8 50	35 10
River St. Francisco	10 55	36 40
Bay of Todos Santos	13 05	39 00
Port Segura	17 00	40 00
Spirito Santo	20 20	40 00
Rio Janero	22 54	42 40
Cape Frio	23 00	40 20
St. Catherine's	27 46	48 00
River Grand	32 00	50 40
Cape Mary	35 00	55 22
River Plate	36 00	57 40
Cape Matas	45 00	64 20
Cape Blanco near River Camaroons	47 00	64 00
Port Desire, to make it with Steeple Rock on the S. side of it	47 30	64 40
Pepys Isle could not be found by Com. Byron	47 20	66 40
River Julian	48 45	65 00
Cape Virgin Mary	52 21	71 44
Straits of Magell. entr.	52 50	72 35
Staten Island	54 30	69 00
Straits le Maire is be- tween Staten I. and Ter- ra del Fuego		
Falkland Island	51 30	60 00
Terra del Fuego, or the Land of Fire, (S. Point of C. Horn	55 50	73 40
Barneveld's Island	56 50	73 00
Cape Noir was made by C. Anfon, when he expected to be 7d. 30m W. from it	54 30	78 40

*The Western Coast of Patagonia,
Chili, &c.*

Cape Disfada and the Twelve Apostles	53 10 S	79 30 W
W. entr. Magellan Straits	53 00	79 00
The Four Evangelists off Cape Victory	52 20	80 30
Cape St. Catalina	51 33	80 20
Com. Anfon's Watering Harbour	46 00	77 45
Baldiva	40 00	76 00

The Western Coast of, &c.

	Lat. S. D.M.	Long. W. D.M.
Chiloe Island } N. P. } S. P.	41 45 43 50	75 0
Concepcion	36 43	72 40
Coquimbo	29 54	71 16
Lima	12 1	76 49
Guayaquil	2 11	81 11
C. Lorenzo	1 2	80 17
Quito	0 13	77 55
Bonaventura Bay	3 18 N	76 50
C. Francis	0 30	80 33
Panama Bay	8 45	79 55
C. Blanco	9 42	85 55
C. Lucre	23 15	111 30
Acapulca	16 44	102 30
Zacatula	17 10	105 0
C. Coriantes	20 18	108 0
New Year's Haven	37 30	125 10
Drake's Harbor	38 45	128 35
West River Entrance	44 30	131 0

	Lat. D.M.	Long. D.M.
Pondicherry	11 56 N	79 27
Fort St. George, or Ma- dras	13 13	80 2
Mafulipatan	16 28	81 40
C. Palmiras	20 40	87 35
Calcutta	22 50	88 2
Balafore	21 20	86
Achen	5 15	95 55
Chandernagore	22 51	88 29
Malacca	2 12	102 10
Siam River Entrance	14 18	100 55
R. Camboida	10 35	104 45
Tonquin	20 50	105 55
Canton	23 8	113 8
Macao	22 13	113 51
Ningpo	30 0	120 50
Nankin	32 7	118 35
Nangafack	32 45	128 50
Pekin	39 54	116 28

*Islands in the East Indies.**The Coast of the Main Continent
in the East Indies.*

Cape of Good Hope	34 29 S.	18 23 E.
Cape False or Hang Lip	34 34	19 15
Cape Aiguilles	34 48	20 22
Bay of Lagoa	33 25	25 53
Cape Natal	31 50	26 0
R. St. Lucie	28 20	30 50
Bay of Holy Spirits, or Laurens Marquez	25 50	31 56
Cape Corrientes	24 8	34 49
R. de Cuama	18 45	38 7
Mozambique	15 4	41 40
Cape Delgada	10 8	41 15
Zanzibar	6 55	42 10
Mombaza	3 50	41 30
Pate I.	1 0	41 52
Magadoxo	2 53 N	45 25
Cape Bafs, or Baxos	4 6	47 8
Cape Gardafoy	11 48	52 20
Cape Arden	12 55	45 35
Straits Babelmandel	12 50	43 50
Mocha in the Red Sea	13 45	44 4
Cape Rosalgate	22 46	58 50
Gulph of Ormus	27 30	55 17
Cape Mozandon	26 6	56 35
Diu Head	21 37	70 28
Goa	15 31	73 50
Suat	21 10	72 25
Cambya Bay	22 10	70 5
Bombay	19 42	73 3
Cochin	9 50	76 5
Cape Comoren	7 45	78 17

St. Paul	38 20 S.	75 25 E.
Bourbon	20 52	55 30
St. Joan de Lisbon	25 24	53 30
Diego Rois	19 50	61 30
Brandon	16 38	64 30
Mauritius	20 10	57 33
Madagascar, St. Maria	25 24	45 53
St. Sebastian, ditto	12 30	49 13
Moelia	13 40	45 0
St. Christova	17 36	45 0
Isles of Camora So. P.	11 40	44 46
Astova	10 22	53 25
St. Juan de Nova	10 0	52 40
Baxos	4 12	47 7
Admiralty Isles	6 0	53 50
Agalega	10 15	54 46
Zenzebar	6 55	40 10
Pemba	5 38	40 9
Lamo	2 30	40 30
Mayetto	12 53	46 10
Marfia	8 37	40 40
Quevelo, or Quebello	3 53	52 36
Baffas de Banhas	5 0	48 8
St. Francisco	6 23	59 0
Island Gratio	6 10	63 1
Three Germans	4 20	62 43
Cross Island	4 10	58 5
Sacatora	12 15 N	52 55
Isles Maldives	7 20	73 3
Ditto South	0 20	76 10
Island Abdeleur	11 55	51 45
Cylone Cape Gallo	16 15	80 20
Andaman the Middle	12 35	93 19
Nicobar N. 6. P.	7 22	94 40
N.W. end of Sumatra	5 22	95 55

Islands in the East Indies.

	Lat. D.M.	Long. D.M. E.		Lat. N D.M.	Long. E. D.M.
S. E. End of Sumatra	5 22 N	105 50	Formosa S. P.	22 0	120 40
Batavia in Java	6 16	106 15	Ditto N. P.	21 25	121 25
Bantam	6 15	106 25	Lekeys S. P.	26 3	127 30
Pulo Candor	8 40	107 20	Tandoxima	30 30	130 40
P. Bornéo N. P.	7 0	113 15	Straits Diemen	31 12	130 55
Ditto S. P.	4 32 S.	113 45	I. Japan S. W. P.	31 30	126 10
Bencola	4 0	102 55	N. E. P.	40 40	141 25
Manila	14 30 N	120 25	Liquio, Kelon	28 0	127 30
Hainam { N. E. P.	19 45	110 13			
{ S. W. P.	18 22	108 13			

Besides the Times of High-Water in the preceding Table, the following Times serve for Coasts of considerable Extent, and will nearly serve for the Places on those Coasts.

Finmark, or N. N. W. Coast of Lapland, 1h. 30m. Jutland Isles 0h. 0m.
 Friesland Coast 7h. 30m. Zeland Coast 1h. 30m.
 Flanders Coast 0h. 0m. Picardy and Normandy Coasts 10h. 30m.
 Biscay, Gallician, and Portugal Coasts 3h. 10m.
 Irish W. Coast 3h. 0m. Irish S. Coast 5h. 15m.
 Africa W. Coast 3h. 0m. America W. Coast 3h. 0m.
 America E. Coast 4h. 30m.

Latitudes and Longitudes of some Places determined by the late Transit of Venus.

			Lat. D. M. S.	Long. D. M. S.
Batavia	_____	Ile Java	6 12 0 S.	106 43 0 E.
Cadiz	_____	Spain	36 31 0 N	6 12 0 W
Cajanebourg	_____	Finland	64 1 30	27 50 45 E.
Cambridge	_____	New England	42 25 0	71 10 0 W
Fort Churchill	_____	Hudson's Bay	58 47 30	94 7 0
Cape Francois	_____	Ile Dominga.	19 57 0	72 10 0
Gibraltar	_____	Spain	36 5 0	4 46 0
Grypswald	_____	Pomerania	54 4 20	13 21 0 E.
Gurjef	_____	Astracan	47 7 0	52 7 0
Cape Hinlopen	_____	Maryland	38 47 30	75 3 0 W
Jakutskoi	_____	Siberia	62 2 0	129 52 0 E.
St. Joseph	_____	California	23 3 30	109 35 0 W
Kola	_____	Lapland	68 52 30	33 8 0 E.
Mexico	_____	New Spain	19 54 0	100 5 0 W
Noriton	_____	Pensylvania	40 10 0	75 17 30
North Cape	_____	Lapland	71 10 0	26 5 0 E.
Orenburg	_____	Astracan	51 46 0	55 14 0
Arsk	_____	Astracan	51 12 30	58 32 30
Ile Otahite	_____	South Seas	17 29 0 S.	149 22 0 W
Pekin	_____	China	39 55 0 N	116 31 0 E.
Peterburg	_____	Russia	59 56 0	30 28 0
Ponoi	_____	Lapiand	68 52 30	33 8 0
Philadelphia	_____	Pensylvania	39 57 0	75 13 0 W
Quebec	_____	Canada	48 47 30	71 12 30
Fort Royal	_____	Ile Martinique	14 36 0	61 15 0

Stockholm.

				Lat.		Long.	
				D. M. S.		D. M. S.	
Stockholm	—	Sweden	—	59	20 30 N	18	8 01
Unbā	—	Russia	—	66	39 45	34	15 0
Upsal	—	Sweden	—	59	52 0	17	43 0
Paris	—	France	—	48	50 0	2	25 0
Gottengen	—	Germany	—	51	32 0	9	59 0
Vienna	—	Ditto	—	48	12 30	16	27 0
Alexandria	—	Egypt	—	31	11 20	30	22 0
Bolona	—	Italy	—	44	29 30	11	20 0
Dronthem	—	Norway	—	63	26 0	11	5 0
Formea	—	Finland	—	65	51 0	26	16 0
Madrid	—	Spain	—	40	26 0	3	16 0
Leyden	—	Holland	—	52	9 0	4	31 0
Madrafs	—	India	—	13	18 0	80	2 0

Whoever will compare these Tables with those in common Books, will find that I have not contented myself with copying from any Book, but have been at some Pain to collect from the best Charts, and correcting them by the best Observations I could procure.

It is common to hear Masters of Ships complaining of the inaccuracy of the Tables of the Flowing of the Tides, and the Latitudes and Longitudes of Places in Books of Navigation; but the Fault does not seem to be so much in the Authors as in the Masters themselves; for if they will not communicate their Observations, it is impossible the Tables should be correct. I can only say, that if they will communicate their correct Observations of Latitude and Longitude, &c. to the Publisher (for I paid) I will make the best of them I can for their Benefit.

The Longitudes of many places have hitherto been but very indifferently ascertained, owing to the Want of the Method of determining them by Celestial Observation, and the uncertainty of that Method commonly used in measuring the Ship's Way: The first of these Difficulties is here removed by the New Method of determining the Longitude by the Moon's Distance from the Sun, or a fixed Star; and the Latter, by the Invention of Mr. FOXON, of Deptford, who has invented a Log that will (as Masters of Ships have informed me) give the Ship's Run for any determined Time with great Accuracy, and without being liable to those Inconveniencies attending the common Log.

Since Navigation is become of such Importance to this Nation, several Persons have endeavoured to recommend themselves to the Public, by inventing something subservient to it; among which, I think, my Friend, Mr. MOORE's Windlass, deserves Notice. This simple Machine is nothing more than a round Plate of Iron, with Notches in it, fixed at one or both Ends of the common Windlass; and by Means of two long Levers, or Palls, and a Piece of Iron to secure their Purchase two Men may heave up the Anchor of a Ship of considerable Burthen without shifting the Bars. If our Navigators would be thus influenced by so laudable an Ambition, in making correct Observations, we should soon have Navigation and Geography brought to a much greater Degree of Perfection than they now are.

M	od.	1d.	2d.	3d.	4d.	5d.	6d.	7d.	8d.	9d.	10d.	11d.	12d.	13d.	M
0	0	60	120	180	240	300	361	421	482	542	602	664	725	787	0
1	1	61	121	181	241	301	362	422	483	543	604	665	726	788	1
2	2	62	122	182	242	302	363	423	484	544	605	666	727	789	2
3	3	63	123	183	243	303	364	424	485	545	606	667	728	790	3
4	4	64	124	184	244	304	365	425	486	546	607	668	729	791	4
5	5	65	125	185	245	305	366	426	487	547	608	669	730	792	5
6	6	66	126	186	246	306	367	427	488	548	609	670	731	793	6
7	7	67	127	187	247	307	368	428	489	549	610	671	732	794	7
8	8	68	128	188	248	308	369	429	490	550	611	672	733	795	8
9	9	69	129	189	249	309	370	430	491	551	612	673	734	796	9
10	10	70	130	190	250	310	371	431	492	552	613	674	735	797	10
11	11	71	131	191	251	311	372	432	493	553	614	675	736	798	11
12	12	72	132	192	252	312	373	433	494	554	615	676	737	799	12
13	13	73	133	193	253	313	374	434	495	555	616	677	738	800	13
14	14	74	134	194	254	314	375	435	496	556	617	678	739	801	14
15	15	75	135	195	255	315	376	436	497	557	618	679	740	802	15
16	16	76	136	196	256	316	377	437	498	558	619	680	741	803	16
17	17	77	137	197	257	317	378	438	499	559	620	681	742	804	17
18	18	78	138	198	258	318	379	439	500	560	621	682	743	805	18
19	19	79	139	199	259	319	380	440	501	561	622	683	744	806	19
20	20	80	140	200	260	320	381	441	502	562	623	684	745	807	20
21	21	81	141	201	261	321	382	442	503	563	624	685	746	808	21
22	22	82	142	202	262	322	383	443	504	564	625	686	747	809	22
23	23	83	143	203	263	323	384	444	505	565	626	687	748	810	23
24	24	84	144	204	264	324	385	445	506	566	627	688	749	811	24
25	25	85	145	205	265	325	386	446	507	567	628	689	750	812	25
26	26	86	146	206	266	326	387	447	508	568	629	690	751	813	26
27	27	87	147	207	267	327	388	448	509	569	630	691	752	814	27
28	28	88	148	208	268	328	389	449	510	570	631	692	753	815	28
29	29	89	149	209	269	329	390	450	511	571	632	693	754	816	29
30	30	90	150	210	270	330	391	451	512	572	633	694	755	817	30
31	31	91	151	211	271	331	392	452	513	573	634	695	756	818	31
32	32	92	152	212	272	332	393	453	514	574	635	696	757	819	32
33	33	93	153	213	273	333	394	454	515	575	636	697	758	820	33
34	34	94	154	214	274	334	395	455	516	576	637	698	759	821	34
35	35	95	155	215	275	335	396	456	517	577	638	699	760	822	35
36	36	96	156	216	276	336	397	457	518	578	639	700	761	823	36
37	37	97	157	217	277	337	398	458	519	579	640	701	762	824	37
38	38	98	158	218	278	338	399	459	520	580	641	702	763	825	38
39	39	99	159	219	279	339	400	460	521	581	642	703	764	826	39
40	40	100	160	220	280	340	401	461	522	582	643	704	765	827	40
41	41	101	161	221	281	341	402	462	523	583	644	705	766	828	41
42	42	102	162	222	282	342	403	463	524	584	645	706	767	829	42
43	43	103	163	223	283	343	404	464	525	585	646	707	768	830	43
44	44	104	164	224	284	344	405	465	526	586	647	708	769	831	44
45	45	105	165	225	285	345	406	466	527	587	648	709	770	832	45
46	46	106	166	226	286	346	407	467	528	588	649	710	771	833	46
47	47	107	167	227	287	347	408	468	529	589	650	711	772	834	47
48	48	108	168	228	288	348	409	469	530	590	651	712	773	835	48
49	49	109	169	229	289	349	410	470	531	591	652	713	774	836	49
50	50	110	170	230	290	350	411	471	532	592	653	714	775	837	50
51	51	111	171	231	291	351	412	472	533	593	654	715	776	838	51
52	52	112	172	232	292	352	413	473	534	594	655	716	777	839	52
53	53	113	173	233	293	353	414	474	535	595	656	717	778	840	53
54	54	114	174	234	294	354	415	475	536	596	657	718	779	841	54
55	55	115	175	235	295	355	416	476	537	597	658	719	780	842	55
56	56	116	176	236	296	356	417	477	538	598	659	720	781	843	56
57	57	117	177	237	297	357	418	478	539	599	660	721	782	844	57
58	58	118	178	238	298	358	419	479	540	600	661	722	783	845	58
59	59	119	179	239	299	359	420	480	541	601	662	723	784	846	59

M	14d.	15d.	16d.	17d.	18d.	19d.	20d.	21d.	22d.	23d.	24d.	25d.	26d.	27d.	M
0	847	910	973	1035	1098	1161	1225	1289	1354	1419	1484	1550	1616	1684	0
1	840	911	974	1036	1099	1162	1226	1290	1355	1420	1485	1551	1617	1685	1
2	851	912	975	1037	1100	1163	1227	1291	1356	1421	1486	1552	1618	1686	2
3	854	914	977	1039	1101	1164	1228	1292	1357	1422	1487	1553	1619	1687	3
4	855	915	977	1040	1102	1165	1229	1293	1358	1423	1488	1554	1620	1688	4
5	854	916	978	1041	1103	1166	1230	1294	1359	1424	1489	1555	1621	1689	5
6	855	917	979	1042	1104	1167	1231	1295	1360	1425	1490	1556	1622	1690	6
7	856	918	980	1043	1105	1168	1232	1296	1361	1426	1491	1557	1623	1691	7
8	855	919	981	1044	1106	1169	1233	1297	1362	1427	1492	1558	1624	1692	8
9	856	920	982	1045	1107	1170	1234	1298	1363	1428	1493	1559	1625	1693	9
10	856	921	983	1046	1108	1171	1235	1299	1364	1429	1494	1560	1626	1694	10
11	860	922	984	1047	1109	1172	1236	1300	1365	1430	1495	1561	1627	1695	11
12	861	923	985	1048	1110	1173	1237	1301	1366	1431	1496	1562	1628	1696	12
13	862	924	986	1049	1111	1174	1238	1302	1367	1432	1497	1563	1629	1697	13
14	862	925	987	1050	1112	1175	1239	1303	1368	1433	1498	1564	1630	1698	14
15	863	926	988	1051	1113	1176	1240	1304	1369	1434	1499	1565	1631	1699	15
16	865	927	989	1052	1114	1177	1241	1305	1370	1435	1500	1566	1632	1700	16
17	866	928	990	1053	1115	1178	1242	1306	1371	1436	1501	1567	1633	1701	17
18	867	929	991	1054	1116	1179	1243	1307	1372	1437	1502	1568	1634	1702	18
19	868	930	992	1055	1117	1180	1244	1308	1373	1438	1503	1569	1635	1703	19
20	870	931	994	1056	1118	1181	1245	1309	1374	1439	1504	1570	1636	1704	20
21	870	932	995	1057	1119	1182	1246	1310	1375	1440	1505	1571	1637	1705	21
22	871	933	996	1058	1120	1183	1247	1311	1376	1441	1506	1572	1638	1706	22
23	872	934	997	1059	1121	1184	1248	1312	1377	1442	1507	1573	1639	1707	23
24	873	935	998	1060	1122	1185	1249	1313	1378	1443	1508	1574	1640	1708	24
25	874	936	999	1061	1123	1186	1250	1314	1379	1444	1509	1575	1641	1709	25
26	875	937	1000	1062	1124	1187	1251	1315	1380	1445	1510	1576	1642	1710	26
27	876	938	1001	1063	1125	1188	1252	1316	1381	1446	1511	1577	1643	1711	27
28	877	939	1002	1064	1126	1189	1253	1317	1382	1447	1512	1578	1644	1712	28
29	878	941	1003	1065	1127	1190	1254	1318	1383	1448	1513	1579	1645	1713	29
30	879	942	1004	1066	1128	1191	1255	1319	1384	1449	1514	1580	1646	1714	30
31	880	943	1005	1067	1129	1192	1256	1320	1385	1450	1515	1581	1647	1715	31
32	881	944	1006	1068	1130	1193	1257	1321	1386	1451	1516	1582	1648	1716	32
33	883	945	1007	1069	1131	1194	1258	1322	1387	1452	1517	1583	1649	1717	33
34	883	946	1008	1070	1132	1195	1259	1323	1388	1453	1518	1584	1650	1718	34
35	885	947	1009	1071	1133	1196	1260	1324	1389	1454	1519	1585	1651	1719	35
36	886	948	1010	1072	1134	1197	1261	1325	1390	1455	1520	1586	1652	1720	36
37	887	949	1011	1073	1135	1198	1262	1326	1391	1456	1521	1587	1653	1721	37
38	888	950	1012	1074	1136	1199	1263	1327	1392	1457	1522	1588	1654	1722	38
39	889	951	1013	1075	1137	1200	1264	1328	1393	1458	1523	1589	1655	1723	39
40	890	952	1014	1076	1138	1201	1265	1329	1394	1459	1524	1590	1656	1724	40
41	891	953	1015	1077	1139	1202	1266	1330	1395	1460	1525	1591	1657	1725	41
42	892	954	1016	1078	1140	1203	1267	1331	1396	1461	1526	1592	1658	1726	42
43	893	955	1017	1079	1141	1204	1268	1332	1397	1462	1527	1593	1659	1727	43
44	894	956	1018	1080	1142	1205	1269	1333	1398	1463	1528	1594	1660	1728	44
45	895	957	1019	1081	1143	1206	1270	1334	1399	1464	1529	1595	1661	1729	45
46	896	958	1020	1082	1144	1207	1271	1335	1400	1465	1530	1596	1662	1730	46
47	897	959	1021	1083	1145	1208	1272	1336	1401	1466	1531	1597	1663	1731	47
48	898	960	1022	1084	1146	1209	1273	1337	1402	1467	1532	1598	1664	1732	48
49	899	961	1023	1085	1147	1210	1274	1338	1403	1468	1533	1599	1665	1733	49
50	900	962	1024	1086	1148	1211	1275	1339	1404	1469	1534	1600	1666	1734	50
51	901	963	1025	1087	1149	1212	1276	1340	1405	1470	1535	1601	1667	1735	51
52	902	964	1026	1088	1150	1213	1277	1341	1406	1471	1536	1602	1668	1736	52
53	903	965	1027	1089	1151	1214	1278	1342	1407	1472	1537	1603	1669	1737	53
54	904	966	1028	1090	1152	1215	1279	1343	1408	1473	1538	1604	1670	1738	54
55	905	967	1029	1091	1153	1216	1280	1344	1409	1474	1539	1605	1671	1739	55
56	906	968	1030	1092	1154	1217	1281	1345	1410	1475	1540	1606	1672	1740	56
57	907	969	1031	1093	1155	1218	1282	1346	1411	1476	1541	1607	1673	1741	57
58	908	970	1032	1094	1156	1219	1283	1347	1412	1477	1542	1608	1674	1742	58
59	909	971	1033	1095	1157	1220	1284	1348	1413	1478	1543	1609	1675	1743	59

M	28d.	30d.	31d.	32d.	33d.	34d.	35d.	36d.	37d.	38d.	39d.	40d.	41d.	M	
0	1751	1819	1888	1958	2028	2100	2171	2244	2318	1393	2468	2545	2623	2702	0
1	52	21	90	59	30	01	73	45	19	94	70	46	24	03	1
2	53	22	91	60	31	02	74	47	20	95	71	48	25	04	2
3	55	23	92	62	32	03	75	48	22	96	72	49	27	06	3
4	56	24	93	63	33	04	76	49	23	98	73	50	28	07	4
5	57	25	94	64	34	05	78	50	24	99	75	51	29	09	5
6	58	26	95	65	35	07	79	52	25	2400	76	53	31	10	6
7	59	27	96	66	37	08	80	53	27	01	77	54	32	11	7
8	60	29	98	67	38	09	81	54	28	03	78	55	33	12	8
9	61	30	99	69	39	10	82	55	29	04	80	57	34	14	9
10	1762	1831	1900	1970	2040	2111	2184	2256	2330	1405	2481	2558	2636	2715	10
11	64	32	01	71	41	13	85	58	32	06	82	59	37	16	11
12	65	33	02	72	43	14	86	59	33	08	84	60	38	18	12
13	66	34	03	73	44	15	87	60	34	09	85	62	40	19	13
14	67	35	05	74	45	16	88	61	35	10	86	63	41	20	14
15	68	37	06	76	46	17	90	63	37	11	87	64	42	22	15
16	69	38	07	77	47	19	91	64	38	13	89	66	44	23	16
17	70	39	08	78	48	20	92	65	39	14	90	67	45	24	17
18	72	40	09	79	50	21	93	66	40	15	91	68	46	26	18
19	73	41	10	80	51	22	94	68	42	16	92	69	48	27	19
20	1774	1842	1911	1981	2052	2123	2196	2269	2343	2418	2494	2571	2649	2728	20
21	75	43	13	83	53	25	97	70	44	19	95	72	50	29	21
22	76	45	14	84	54	26	98	71	45	20	96	73	51	31	22
23	77	46	15	85	56	27	99	72	46	21	98	75	53	32	23
24	78	47	16	86	57	28	2200	74	48	23	99	76	54	33	24
25	80	48	17	87	58	29	02	75	49	24	2500	77	55	35	25
26	81	49	18	88	59	31	03	76	50	25	01	78	57	36	26
27	82	50	20	90	60	32	04	77	51	27	03	80	58	37	27
28	83	52	21	91	61	33	05	79	53	28	04	81	59	39	28
29	84	53	22	92	63	34	07	80	54	29	05	82	61	40	29
30	1785	1854	1923	1993	2064	2135	2208	2281	2355	2430	2506	2584	2662	2742	30
31	86	55	24	94	65	37	09	82	56	32	08	85	63	43	31
32	87	56	25	95	66	38	10	83	58	33	09	86	65	44	32
33	89	57	27	97	67	39	11	85	59	34	10	88	66	46	33
34	90	58	28	88	69	40	13	86	60	35	12	89	67	47	34
35	91	60	29	99	70	41	14	87	61	37	13	90	69	48	35
36	92	61	30	2000	71	43	15	88	63	38	14	91	70	50	36
37	83	62	31	01	72	44	16	90	64	39	15	93	71	51	37
38	94	63	32	02	73	45	17	91	65	40	17	94	73	52	38
39	96	64	34	04	75	47	19	92	66	42	18	95	74	54	39
40	1797	1865	1935	2005	2076	2147	2220	2293	2368	2443	2519	2597	2675	2755	40
41	98	66	36	06	77	49	21	95	69	44	21	98	76	56	41
42	99	68	37	07	78	50	22	96	70	45	22	99	78	58	42
43	1800	69	38	08	79	51	24	97	71	47	23	2601	79	59	43
44	01	70	39	10	80	52	25	98	73	48	24	02	80	60	44
45	02	71	41	11	82	53	26	99	74	49	26	03	81	62	45
46	03	72	42	12	83	55	27	2301	75	51	27	04	82	63	46
47	05	73	43	13	84	56	28	02	76	52	28	05	84	64	47
48	06	75	44	14	85	57	30	03	78	53	30	07	86	66	48
49	07	76	45	15	86	58	31	04	79	54	31	08	87	67	49
50	1808	1877	1946	2017	2088	2159	2232	2306	2380	2456	2532	2610	2688	2768	50
51	09	78	48	18	89	61	33	07	81	57	32	11	90	70	51
52	10	79	49	19	90	62	35	08	83	58	35	12	91	71	52
53	11	80	50	20	91	63	36	09	84	59	36	14	92	72	53
54	13	81	51	21	92	64	37	11	85	61	37	15	94	74	54
55	14	83	52	22	94	65	38	12	86	62	38	16	95	75	55
56	15	84	53	24	95	67	39	13	88	63	40	17	96	76	56
57	16	85	55	25	96	68	41	14	89	64	41	19	98	78	57
58	17	86	56	26	97	69	42	16	90	66	42	20	99	79	58
59	18	87	57	27	98	70	43	17	91	67	44	21	2700	80	59

M	42d.	43d.	44d.	45d.	46d.	47d.	48d.	49d.	50d.	51d.	52d.	53d.	54d.	55d.	M
0	2782	2863	2946	3030	3116	3203	3292	3382	3474	3569	3665	3764	3865	3968	0
1	83	64	47	31	17	04	93	84	76	70	67	65	66	70	1
2	84	66	49	33	18	06	95	85	78	72	68	67	68	71	2
3	86	67	50	34	20	07	96	87	79	74	70	69	70	72	3
4	87	69	51	36	21	09	98	88	81	75	72	70	71	73	4
5	88	70	53	37	23	10	99	90	82	77	73	72	72	75	5
6	90	71	54	38	24	12	3301	91	84	78	75	74	75	78	6
7	91	73	56	40	26	13	02	93	85	80	77	75	77	80	7
8	92	74	57	41	27	14	03	94	87	81	78	77	78	82	8
9	94	75	58	43	29	16	05	96	88	83	80	79	80	84	9
10	2795	2877	2960	3044	3130	3217	3306	3397	3490	3585	3681	3780	3882	3985	10
11	97	78	61	46	31	19	08	99	92	86	83	82	83	87	11
12	98	80	63	47	33	20	09	3400	93	88	85	84	85	89	12
13	99	81	94	48	34	22	11	02	96	90	86	85	87	91	13
14	2801	82	65	50	36	23	12	03	96	91	88	87	89	92	14
15	02	84	67	51	37	25	14	05	98	93	90	89	90	94	15
16	03	85	68	53	39	26	16	07	99	94	91	90	92	96	16
17	05	86	70	54	40	28	17	08	3501	95	93	92	94	98	17
18	06	88	71	55	42	29	19	10	03	98	95	94	95	99	18
19	07	80	72	57	43	31	20	11	04	99	96	95	97	4001	19
20	2809	2891	2974	3058	3144	3232	3322	3413	3506	3601	3698	3797	3899	4003	20
21	10	92	75	60	46	34	23	14	07	02	99	99	3901	05	21
22	11	93	76	61	47	35	25	16	09	04	3701	3800	02	06	22
23	13	95	78	63	49	37	26	17	10	06	03	02	04	08	23
24	14	96	79	64	50	38	28	19	12	07	04	04	06	10	24
25	15	97	81	65	52	40	29	20	14	09	06	06	07	12	25
26	17	99	82	67	53	41	31	22	15	10	08	07	09	14	26
27	18	2900	83	68	55	42	32	23	17	12	09	09	11	15	27
28	20	01	85	70	56	44	34	25	18	14	11	11	13	17	28
29	21	03	86	71	57	45	35	27	20	15	13	12	14	19	29
30	2822	2904	2988	3073	3159	3247	3337	3428	3521	3617	3714	3814	3916	4021	30
31	24	06	89	74	60	48	38	30	23	18	16	16	18	22	31
32	25	07	91	75	62	50	40	31	25	20	17	17	19	24	32
33	26	08	92	77	63	51	41	33	26	22	19	19	21	26	33
34	28	10	93	78	65	53	43	34	28	23	21	21	23	28	34
35	29	11	95	80	66	54	44	36	29	25	22	22	25	29	35
36	30	13	96	81	68	56	46	37	31	26	24	24	26	31	36
37	32	14	98	83	69	57	47	39	32	28	26	26	28	33	37
38	33	15	99	84	71	59	49	40	34	30	27	27	30	35	38
39	34	17	3000	85	72	60	50	42	36	31	29	29	32	37	39
40	2836	2918	3002	3087	3173	3262	3352	3443	3537	3633	3731	3831	3933	4038	40
41	37	19	03	88	75	63	53	45	29	34	32	32	35	40	41
42	39	21	05	90	76	65	55	47	40	36	34	34	37	42	42
43	40	22	06	91	78	66	56	48	42	38	36	36	38	44	43
44	41	24	07	93	79	68	58	50	43	39	37	38	40	45	44
45	43	25	09	94	81	69	59	51	45	41	39	39	42	47	45
46	44	26	10	95	82	71	61	53	47	43	41	41	44	49	46
47	45	28	12	97	84	72	62	54	48	44	42	43	45	51	47
48	47	29	13	98	85	74	64	56	50	46	44	44	47	52	48
49	48	31	14	3100	87	75	65	57	51	47	46	46	49	54	49
50	2849	2932	3016	3101	3188	3277	3367	3459	3553	3649	3747	3848	3951	4056	50
51	51	33	17	03	90	78	68	60	55	51	49	49	52	58	51
52	52	35	19	04	91	80	70	62	56	52	50	51	54	60	52
53	54	36	20	05	92	81	71	64	58	54	52	53	56	61	53
54	55	37	21	07	94	83	73	65	59	55	54	55	58	63	54
55	56	39	23	08	96	84	74	67	60	57	55	56	59	65	55
56	58	40	24	10	97	86	76	68	62	59	57	58	61	67	56
57	59	42	26	11	98	87	78	70	64	60	59	60	63	69	57
58	60	43	27	12	3200	89	79	71	66	62	60	61	64	70	58
59	62	44	28	14	01	90	81	73	67	64	62	63	66	72	59

A Table of Meridional Parts.

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M	56d.	57d.	58d.	59d.	60d.	61d.	62d.	63d.	64d.	65d.	66d.	67d.	68d.	69d.	M
0	4074	4183	4294	4409	4527	4649	4775	4905	5039	5179	5324	5474	5631	5795	0
1	76	84	96	11	29	51	77	07	42	81	26	77	33	97	1
2	77	86	98	13	31	53	79	09	44	84	28	79	36	5800	2
3	79	88	4300	15	33	55	81	12	46	86	31	82	39	03	3
4	81	90	02	17	35	57	84	14	49	88	33	84	41	06	4
5	83	92	04	19	37	60	86	16	51	91	36	87	44	09	5
6	85	94	06	21	39	62	88	18	53	93	38	89	47	11	6
7	86	95	08	23	41	64	90	20	55	95	41	92	50	14	7
8	88	97	09	25	43	66	92	23	58	98	43	95	52	17	8
9	90	99	11	27	45	68	94	25	60	5200	46	97	55	20	9
10	4092	4201	4313	4429	4547	4670	4796	4927	5062	5203	5348	5500	5658	5823	10
11	94	03	15	31	49	72	98	29	65	05	51	02	60	25	11
12	65	05	17	33	51	74	4801	31	67	07	53	05	63	28	12
13	97	07	19	34	53	76	03	34	69	10	56	07	66	31	13
14	99	08	20	36	55	78	05	36	71	12	58	10	68	34	14
15	4101	10	23	38	57	80	07	38	74	14	61	13	71	37	15
16	03	12	25	40	59	82	09	40	76	17	63	15	74	39	16
17	04	14	27	42	62	84	11	43	78	19	66	18	76	42	17
18	06	16	28	44	64	87	14	45	81	22	68	20	79	45	18
19	08	18	30	46	66	89	16	47	83	24	71	23	82	48	19
20	4110	4220	4332	4448	4568	4691	4818	4949	5085	5226	5373	5526	5685	5851	20
21	12	21	34	50	70	93	20	51	88	29	76	28	87	54	21
22	13	23	36	52	72	95	22	54	90	31	78	31	90	56	22
23	15	25	38	54	74	97	24	56	92	34	80	33	93	59	23
24	17	27	40	56	76	99	26	58	95	36	83	36	95	62	24
25	19	29	42	58	78	4701	29	60	97	38	85	39	98	65	25
26	21	31	44	60	80	03	31	63	99	41	81	41	5701	68	26
27	22	32	46	62	82	05	33	65	5102	43	90	44	04	71	27
28	24	34	47	64	84	07	35	67	04	46	93	46	06	74	28
29	26	36	49	66	86	10	37	69	06	48	95	49	09	76	29
30	4128	4238	4351	4468	4588	4712	4839	4972	5108	5250	5398	5552	5712	5879	30
31	30	40	53	70	90	14	42	74	11	53	5401	54	15	82	31
32	32	42	55	72	92	16	44	76	13	55	03	57	17	85	32
33	33	44	57	74	94	18	46	78	15	58	06	59	20	88	33
34	35	46	59	76	96	20	48	81	18	60	08	62	23	91	34
35	37	47	61	78	98	22	50	83	20	63	11	65	25	94	35
36	39	49	63	80	4600	24	52	85	22	65	13	67	28	96	36
37	41	51	65	82	02	26	55	87	25	67	16	70	31	99	37
38	42	53	67	84	04	28	57	90	27	70	18	73	34	5902	38
39	44	55	69	86	06	31	59	92	29	72	21	75	36	05	39
40	4146	4257	4370	4488	4608	4733	4861	4994	5132	5275	5423	5578	5739	5908	40
41	48	59	72	90	10	35	63	96	34	77	29	80	42	11	41
42	50	60	74	92	12	37	65	99	36	80	28	83	45	14	42
43	52	62	76	94	14	39	68	5001	39	82	31	86	47	17	43
44	53	64	78	95	19	41	70	03	41	84	33	88	50	19	44
45	55	66	80	97	18	43	72	05	43	87	36	91	53	22	45
46	57	68	82	99	20	45	74	08	46	89	38	94	56	25	46
47	59	70	84	4501	23	47	76	10	48	92	41	96	58	28	47
48	61	72	86	03	25	50	79	12	51	94	43	99	61	31	48
49	62	74	88	05	27	52	81	14	53	97	46	5602	64	34	49
50	4164	4275	4390	4507	4629	4754	4883	5017	5155	5299	5448	5604	5767	5937	50
51	66	77	92	09	31	56	85	19	58	5301	51	07	70	40	51
52	68	79	94	11	33	58	87	21	60	04	54	10	72	43	52
53	70	81	96	13	35	60	90	23	62	06	56	12	75	46	53
54	72	83	98	15	35	62	92	26	65	09	59	15	78	48	54
55	73	85	99	17	39	64	94	28	67	11	61	17	81	51	55
56	75	87	4401	19	41	66	96	30	69	14	64	20	83	54	56
57	77	89	03	21	43	69	98	33	72	16	66	23	86	57	57
58	79	91	05	23	45	71	4901	35	74	19	69	25	89	60	58
59	80	92	07	25	47	73	03	37	76	21	71	28	92	63	59

M	70d.	71d.	72d.	73d.	74d.	75d.	76d.	77d.	78d.	79d.	80d.	81d.	82d.	83d.	M
0	5966	6146	6335	653	6746	6970	721	746	7745	8041	8375	8759	9145	9606	0
1	69	49	38	38	49	74	14	72	49	51	81	45	53	14	1
2	72	52	41	41	53	78	18	76	54	56	87	52	60	22	2
3	75	55	45	4	57	82	22	81	59	61	93	58	67	31	3
4	78	58	48	48	60	86	27	85	64	67	98	65	74	39	4
5	81	61	51	52	64	90	31	90	69	72	104	71	82	47	5
6	84	64	54	55	68	94	35	94	74	77	110	78	89	55	6
7	86	67	58	58	71	97	39	98	78	83	116	84	96	64	7
8	89	70	61	62	75	100	43	103	83	88	122	91	103	72	8
9	92	73	64	65	79	104	47	107	88	93	127	95	111	81	9
10	5995	6177	6367	656	6782	7009	7252	7512	7791	8099	8433	8804	9216	9689	10
11	94	80	71	72	86	13	56	11	97	104	39	10	25	97	11
12	6001	81	74	75	90	17	60	21	100	09	45	17	34	9706	12
13	04	86	77	78	93	21	64	2	08	15	51	23	40	14	13
14	07	89	80	81	97	25	68	30	13	20	57	30	44	21	14
15	10	92	84	85	101	29	73	35	17	25	63	36	50	31	15
16	13	95	87	88	104	33	77	39	22	31	69	4	62	40	16
17	16	98	90	91	108	37	81	44	27	35	74	49	70	48	17
18	19	6201	94	95	12	41	85	48	32	41	80	56	77	57	18
19	22	06	97	98	15	45	89	53	37	47	86	62	80	65	19
20	6026	6208	6400	6603	6816	7040	7294	7557	7844	8152	8492	8869	9292	9774	20
21	24	11	03	07	23	52	98	62	47	68	98	70	9300	83	21
22	31	14	07	10	26	56	103	66	52	62	104	83	07	91	22
23	34	17	10	14	30	60	06	71	57	68	110	89	15	9800	23
24	37	20	13	17	34	64	11	76	62	74	116	96	22	09	24
25	40	23	17	21	38	68	15	80	67	79	122	103	30	17	25
26	43	26	20	24	41	72	19	85	72	85	128	109	37	26	26
27	46	30	23	28	45	76	23	89	77	90	134	116	45	35	27
28	49	33	27	31	49	80	28	94	82	96	140	123	53	44	28
29	52	36	30	35	53	84	32	99	86	101	146	130	60	52	29
30	6055	6239	6433	6639	6856	7088	7336	7603	7892	8207	8552	8936	9368	9861	30
31	58	42	37	42	60	92	41	08	97	12	58	43	76	70	31
32	61	45	40	46	64	96	45	12	100	18	65	50	83	79	32
33	64	49	43	49	68	100	49	17	07	23	71	57	91	88	33
34	67	52	47	53	71	04	53	22	12	29	77	63	99	97	34
35	70	55	50	56	75	08	58	26	17	34	83	70	106	106	35
36	73	58	53	60	79	12	62	31	22	40	89	77	114	115	36
37	76	61	57	63	83	16	66	36	27	45	95	84	122	124	37
38	79	64	60	67	86	20	71	40	32	51	101	91	130	133	38
39	82	68	63	70	90	24	75	45	37	56	107	98	138	142	39
40	6085	6271	6467	6674	6894	7128	7379	7650	7942	8262	8614	9005	9446	9951	40
41	88	74	70	77	98	32	84	54	48	67	10	12	53	59	41
42	91	77	73	81	101	36	88	59	53	73	26	18	61	69	42
43	94	80	77	85	105	40	92	64	58	79	32	25	69	78	43
44	97	83	80	88	109	45	97	68	63	84	36	32	77	87	44
45	100	87	83	92	113	49	101	73	68	90	44	39	85	99	45
46	03	90	87	95	117	53	06	78	73	95	51	46	93	100	46
47	06	93	90	99	120	57	10	83	78	101	57	53	101	101	47
48	09	96	94	102	124	61	14	87	83	07	63	60	09	102	48
49	12	00	07	06	128	65	19	92	89	12	69	67	17	103	49
50	6115	6303	6502	6710	6932	7169	7423	7697	7994	8318	8676	9074	9525	10043	50
51	18	06	04	13	36	73	27	102	99	24	82	81	33	100	51
52	21	09	07	17	40	77	32	06	104	29	88	88	41	100	52
53	24	12	11	20	43	81	36	11	09	35	95	96	49	100	53
54	27	15	14	24	47	85	41	16	14	41	101	103	57	100	54
55	30	19	17	28	51	89	45	21	20	47	07	10	65	100	55
56	33	22	21	31	55	94	49	25	25	52	14	17	73	100	56
57	36	25	24	35	59	98	54	30	30	58	20	24	81	101	57
58	4	28	28	38	63	102	58	35	35	64	26	31	89	101	58
59	43	32	31	42	67	06	63	40	40	69	33	38	98	101	59

M	4 d.	8 d.	16 d.	32 d.	64 d.	128 d.	256 d.	M
0	10137	10765	11533	12522	13910	16300	0	
1	147	776	547	541	945	357	1	
2	157	788	561	561	974	416	2	
3	166	799	576	580	1003	470	3	
4	175	811	590	599	1033	537	4	
5	185	822	605	619	1063	599	5	
6	195	834	620	639	1093	662	6	
7	205	846	634	653	1123	726	7	
8	214	858	649	679	1154	792	8	
9	224	869	664	699	1184	858	9	
10	10234	10881	11679	12719	14216	16926	10	
11	244	893	694	739	247	996	11	
12	254	905	709	759	279	1067	12	
13	264	917	724	780	311	1139	13	
14	273	929	739	801	343	1213	14	
15	283	941	755	821	376	1289	15	
16	293	953	770	842	408	1366	16	
17	303	965	785	863	442	1445	17	
18	314	978	801	884	475	1526	18	
19	324	990	816	906	509	1600	19	
20	10334	11002	11832	12927	14543	17693	20	
21	344	014	848	949	578	781	21	
22	354	027	863	970	613	870	22	
23	364	039	879	992	648	962	23	
24	374	052	895	1013	684	1056	24	
25	385	064	911	1036	720	1153	25	
26	395	077	927	1059	756	1252	26	
27	405	089	943	1081	793	1355	27	
28	416	102	959	1104	830	1461	28	
29	426	115	976	1126	868	1570	29	
30	10437	11127	11992	13149	14906	18682	30	
31	447	140	12008	172	943	799	31	
32	457	153	025	195	983	920	32	
33	468	166	041	219	1022	1045	33	
34	478	179	058	242	062	1174	34	
35	486	192	075	266	102	1309	35	
36	500	205	092	290	143	1450	36	
37	510	218	109	314	184	1596	37	
38	521	231	126	338	229	1749	38	
39	532	244	143	362	268	1909	39	
40	10542	11257	12160	13386	15311	20076	40	
41	553	270	177	411	354	243	41	
42	564	284	194	437	398	429	42	
43	575	297	212	462	442	685	43	
44	586	310	229	486	487	843	44	
45	597	324	247	511	532	1065	45	
46	608	337	264	537	579	1303	46	
47	619	351	282	563	625	1557	47	
48	630	365	300	589	673	1832	48	
49	641	378	318	615	721	2132	49	
50	10652	11392	12337	13641	15770	22459	50	
51	663	406	354	668	819	22821	51	
52	674	420	372	695	869	23226	52	
53	685	434	391	721	920	23685	53	
54	696	448	409	749	972	24215	54	
55	708	462	428	776	1024	24842	55	
56	719	476	447	804	078	25609	56	
57	730	490	465	832	132	26598	57	
58	742	404	484	860	187	27992	58	
59	758	518	503	888	243	30375	59	

The Use of the Table of the Meridional Parts.

IN this Table the first and last Column of every Page marked M, beginning at 0, and ending at 59, contain the Minutes answering to every Degree of Latitude, the other Columns marked 1d, 2d, &c. contain the Meridional Parts, answering to the Degree of Latitude they stand under.

So that if you would find the Meridional Parts answering to any Latitude, suppose for Example, the Latitude 51. 32, look in the Column under 51d. and right against 32 (in the Column for Minutes) you find 20, to which prefix 36, the two Figures in the same Column that stands above 20 towards the Left hand, and it makes 3620, the Meridional Parts required.

Two Latitudes being given, to find the Meridional Difference of Latitude.

Case 1st, If both Latitudes be North or both South, subtract the Meridional Parts of the Lesser, from the Meridional Parts of the Greater, the Remainder will be the Meridional Difference of Latitude.

Case 2d, If one Latitude be North and the other South, then add their Meridional Parts together, and the Sum will be the Meridional Difference of Latitude.

DECLINATION IN DEGREES.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000
--	---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----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A TABLE OF AMPLITUDES.

307

DECLINATION IN DEGREES																															
Lat.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.
34	1, 12	2, 25	3, 37	4, 50	5, 6	6, 2	7, 15	8, 27	9, 39	10, 52	12, 5	13, 18	14, 31	15, 44	16, 57	18, 11	19, 25	20, 39	21, 53	23, 7	24, 21	25, 36	26, 51	28, 7	28, 44	29, 7	29, 24	29, 51	30, 18	30, 45	
35	1, 13	2, 27	3, 40	4, 53	5, 6	6, 2	7, 20	8, 33	9, 47	11, 0	12, 14	13, 28	14, 42	15, 55	17, 11	18, 25	19, 40	20, 55	22, 10	23, 25	24, 40	25, 56	27, 13	28, 29	29, 7	29, 34	29, 61	30, 18	30, 45	30, 72	
36	1, 14	2, 28	3, 43	4, 57	5, 11	6, 11	7, 25	8, 39	9, 54	11, 9	12, 23	13, 38	14, 53	16, 9	17, 24	18, 39	19, 55	21, 11	22, 27	23, 43	25, 0	26, 18	27, 35	28, 53	29, 11	29, 38	29, 65	30, 22	30, 49	30, 76	
37	1, 15	2, 30	3, 45	5, 0	6, 15	7, 31	8, 46	10, 2	11, 17	12, 33	13, 49	15, 5	16, 21	17, 38	18, 54	20, 11	21, 28	22, 46	24, 3	25, 21	26, 39	27, 58	29, 17	29, 56	30, 15	30, 42	30, 69	31, 26	31, 53	32, 10	
38	1, 16	2, 32	3, 48	5, 5	6, 21	7, 37	9, 54	10, 11	11, 27	12, 44	14, 1	15, 18	16, 35	17, 53	19, 10	20, 28	21, 46	23, 5	24, 24	25, 43	27, 3	28, 23	29, 43	30, 3	30, 30	30, 57	31, 14	31, 41	31, 68	32, 25	
39	1, 17	2, 34	3, 51	5, 8	6, 26	7, 43	9, 9	10, 19	11, 37	12, 54	14, 12	15, 31	16, 49	18, 8	19, 27	20, 46	22, 6	23, 26	24, 46	26, 3	27, 27	28, 49	30, 11	30, 51	31, 10	31, 37	31, 64	32, 21	32, 48	33, 5	
40	1, 18	2, 36	3, 55	5, 13	6, 32	7, 50	9, 9	10, 28	11, 47	13, 6	14, 25	15, 45	17, 5	18, 24	19, 44	21, 5	22, 26	23, 47	25, 9	26, 31	27, 53	29, 16	30, 40	31, 22	31, 49	31, 76	32, 33	32, 60	33, 17	33, 44	
41	1, 19	2, 39	3, 58	5, 18	6, 38	7, 57	9, 17	10, 37	11, 57	13, 18	14, 39	16, 0	17, 21	18, 42	20, 4	21, 26	22, 48	24, 10	25, 33	26, 56	28, 21	29, 46	31, 11	31, 53	32, 10	32, 37	32, 64	33, 21	33, 48	34, 5	
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43	1, 22	2, 44	4, 6	5, 28	6, 51	8, 13	9, 35	10, 58	12, 21	13, 44	15, 7	16, 31	17, 55	19, 19	20, 43	22, 8	23, 34	24, 59	26, 25	27, 53	29, 20	30, 48	32, 16	33, 0	33, 27	33, 54	34, 11	34, 38	34, 65	35, 22	
44	1, 23	2, 47	4, 10	5, 34	6, 58	8, 21	9, 45	11, 9	12, 34	13, 58	15, 23	16, 48	18, 13	19, 39	21, 5	22, 35	23, 59	25, 26	26, 54	28, 23	29, 53	31, 22	32, 51	33, 37	34, 14	34, 41	34, 68	35, 25	35, 52	36, 9	
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46	1, 26	2, 53	4, 19	5, 46	7, 12	8, 39	10, 6	11, 34	13, 1	14, 28	15, 56	17, 25	18, 54	20, 23	21, 52	23, 23	24, 53	26, 25	27, 58	29, 31	31, 3	32, 37	34, 12	35, 0	35, 27	35, 54	36, 11	36, 38	36, 65	37, 22	
47	1, 28	2, 56	4, 24	5, 52	7, 20	8, 49	10, 18	11, 47	13, 16	14, 44	16, 15	17, 45	19, 16	20, 47	22, 18	23, 50	25, 23	26, 57	28, 32	30, 7	31, 42	33, 18	34, 56	35, 46	36, 13	36, 40	36, 67	37, 24	37, 51	38, 8	
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49	1, 31	3, 0	4, 34	6, 6	7, 38	9, 10	10, 42	12, 14	13, 47	15, 21	16, 54	18, 28	20, 3	21, 38	23, 14	24, 51	26, 28	28, 6	29, 45	31, 25	33, 6	34, 48	36, 33	37, 26	38, 3	38, 30	38, 57	39, 14	39, 41	39, 68	
50	1, 33	3, 3	4, 40	6, 14	7, 48	9, 21	10, 55	12, 29	14, 5	15, 40	17, 16	18, 52	20, 29	22, 6	23, 45	25, 24	27, 3	28, 43	30, 25	32, 8	33, 52	35, 37	37, 26	38, 20	38, 47	38, 74	38, 101	38, 128	38, 155	38, 182	
51	1, 35	3, 10	4, 46	6, 22	7, 58	9, 33	11, 9	12, 46	14, 24	16, 1	17, 39	19, 18	20, 57	22, 37	24, 18	25, 59	27, 41	29, 24	31, 8	32, 54	34, 41	36, 30	38, 23	39, 19	39, 46	39, 73	39, 100	39, 127	39, 154	39, 181	
52	1, 37	3, 15	4, 52	6, 30	8, 8	9, 46	11, 24	13, 3	14, 43	16, 23	18, 3	19, 44	21, 26	23, 8	24, 52	26, 36	28, 21	30, 7	31, 55	33, 44	35, 34	37, 27	39, 24	40, 23	40, 50	40, 77	40, 104	40, 131	40, 158	40, 185	
53	1, 40	3, 20	4, 59	6, 39	8, 19	10, 0	11, 40	13, 21	15, 3	16, 46	18, 29	20, 12	21, 57	23, 42	25, 28	27, 16	29, 4	30, 53	32, 45	34, 38	36, 33	38, 29	40, 29	41, 29	41, 56	41, 83	41, 110	41, 137	41, 164	41, 191	
54	1, 42	3, 24	5, 6	6, 49	8, 31	10, 15	11, 57	13, 41	15, 26	17, 11	18, 57	20, 43	22, 30	24, 18	26, 7	27, 58	29, 50	31, 42	33, 38	35, 35	37, 32	39, 26	41, 40	42, 46	42, 73	42, 100	42, 127	42, 154	42, 181	42, 208	
55	1, 45	3, 29	5, 14	6, 59	8, 44	10, 30	12, 15	14, 2	15, 49	17, 37	19, 26	21, 14	23, 5	24, 56	26, 49	28, 43	30, 39	32, 35	34, 35	36, 36	38, 39	40, 47	42, 56	44, 0	44, 27	44, 54	44, 81	44, 108	44, 135	44, 162	
56	1, 47	3, 34	5, 22	7, 10	8, 57	10, 47	12, 35	14, 24	16, 14	18, 5	19, 56	21, 49	23, 43	25, 37	27, 34	29, 32	31, 31	33, 33	35, 36	37, 42	39, 51	42, 4	44, 19	45, 27	45, 54	45, 81	45, 108	45, 135	45, 162	45, 189	
57	1, 50	3, 40	5, 31	7, 22	9, 11	11, 4	12, 56	14, 48	16, 45	18, 33	20, 29	22, 25	24, 23	26, 21	28, 22	30, 24	32, 27	34, 34	36, 36	38, 53	41, 9	43, 27	45, 50	47, 2	47, 29	47, 56	47, 83	47, 110	47, 137	47, 164	
58	1, 53	3, 46	5, 40	7, 34	9, 26	11, 22	13, 18	15, 14	17, 10	19, 7	21, 04	23, 4	25, 0	27, 9	29, 14	31, 21	33, 28	35, 40	37, 54	40, 12	42, 34	44, 59	47, 30	48, 46	48, 73	48, 100	48, 127	48, 154	48, 181	48, 208	
59	1, 56	3, 53	5, 50	7, 47	9, 43	11, 42	13, 41	15, 41	17, 41	19, 41	21, 43	23, 47	25, 54	28, 1	30, 12	32, 22	34, 32	36, 53	39, 13	41, 31	43, 44	46, 40	49, 21	50, 51	50, 78	50, 105	50, 132	50, 159	50, 186	50, 213	
60	2, 0	4, 0	6, 0	8, 1	10, 2	12, 4	14, 6	16, 10	18, 14	20, 18	22, 26	24, 34	26, 44	28, 55	31, 9	33, 27	35, 47	38, 9	40, 36	43, 10	45, 48	48, 31	51, 24	52, 51	52, 78	52, 105	52, 132	52, 159	52, 186	52, 213	
61	2, 3	4, 8	6, 12	8, 17	10, 21	12, 27	14, 34	16, 40	18, 49	20, 57	23, 10	25, 23	27, 39	29, 56	32, 16	34, 39	37, 5	39, 36	42, 11	44, 52	47, 40	50, 35	53, 42	55, 17	55, 44	55, 71	55, 98	55, 125	55, 152	55, 179	
62	2, 7	4, 15	6, 24	8, 32	10, 41	12, 52	15, 2	17, 14	19, 28	21, 42	23, 59	26, 17	28, 37	31, 1	33, 27	35, 57	38, 31	41, 10	43, 54	46, 46	49, 46	52, 56	56, 20	58, 4	58, 31	58, 58	58, 85	58, 112	58, 139	58, 166	
63	2, 12	4, 24	6, 37	8, 50	11, 4	13, 19	15, 34	17, 51	20, 9	22, 27	24, 51	27, 15	29, 42	32, 12	34, 45	37, 23	40, 5	42, 54	45, 49	48, 53	52, 7	55, 36	59, 24	61, 22	61, 49	61, 76	61, 103	61, 130	61, 157	61, 184	
64	2, 17	4, 33	6, 51	9, 11	11, 28	13, 47	16, 8	18, 30	20, 54	23, 18	25, 48	28, 19	30, 52	33, 30	36, 11	38, 57	41, 49	44, 39	47, 57	51, 17	54, 50	58, 43	63, 2	65, 22	65, 49	65, 76	65, 103	65, 130	65, 157	65, 184	
65	2, 22	4, 44	7, 6	9, 30	11, 54	14, 19	16, 45	19, 13	21, 43	24, 13	26, 50	29, 28	32, 9	34, 55	37, 46	40, 42	43, 46	46, 59	50, 23	54, 2	57, 59	62, 26	67, 36	70, 33	70, 60	70, 87	70, 114	70, 141	70, 168	70, 195	
66	2, 27	4, 55	7, 23	9, 52	12, 21	14, 53	17, 26	20, 0	22, 37	25, 14	27, 58	30, 44	33, 34	36, 29	39, 31	42, 40	45, 58	49, 26	51, 11	57, 14	61, 47	67, 4	73, 52	78, 25	78, 52	78, 79	78, 106	78, 133	78, 160	78, 187	

A TABLE of the SUN'S RIGHT ASCENSION.

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
days	South	South	South	North	North	North	North	North	North	South	South	South	Days
	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	
1	18 48	21 0	22 49	0 43	2 34	4 36	6 41	8 46	10 42	12 30	14 26	16 30	1
2	18 52	21 4	22 53	0 46	2 38	4 41	6 45	8 49	10 45	12 33	14 30	16 34	2
3	18 57	21 8	22 57	0 50	2 41	4 45	6 49	8 53	10 49	12 41	14 34	16 39	3
4	19 1	21 12	23 0	0 53	2 45	4 49	6 53	8 57	10 52	12 44	14 38	16 43	4
5	19 6	21 16	23 4	0 57	2 49	4 53	6 57	9 1	10 56	12 48	14 42	16 47	5
6	19 10	21 20	23 8	1 1	2 53	4 57	7 1	9 5	11 0	12 52	14 46	16 52	6
7	19 14	21 24	23 11	1 4	2 57	5 1	7 5	9 9	11 3	12 55	14 50	16 56	7
8	19 19	21 28	23 15	1 8	3 1	5 5	7 10	9 12	11 7	12 59	14 54	17 0	8
9	19 23	21 32	23 19	1 12	3 4	5 9	7 14	9 16	11 11	13 3	14 58	17 5	9
10	19 27	21 36	23 22	1 15	3 8	5 13	7 18	9 20	11 14	13 6	15 2	17 9	10
11	19 32	21 40	23 26	1 19	3 12	5 18	7 22	9 24	11 18	13 10	15 6	17 14	11
12	19 36	21 44	23 30	1 23	3 16	5 22	7 26	9 28	11 21	13 14	15 10	17 18	12
13	19 40	21 48	23 33	1 26	3 20	5 26	7 30	9 31	11 25	13 17	15 14	17 23	13
14	19 45	21 52	23 37	1 30	3 24	5 30	7 34	9 35	11 28	13 21	15 18	17 27	14
15	19 49	21 56	23 41	1 34	3 28	5 34	7 38	9 39	11 32	13 25	15 22	17 31	15
16	19 53	22 0	23 44	1 37	3 32	5 38	7 42	9 43	11 36	13 29	15 26	17 36	16
17	19 58	22 4	23 48	1 41	3 36	5 43	7 46	9 46	11 39	13 32	15 31	17 40	17
18	20 2	22 7	23 52	1 45	3 40	5 47	7 50	9 50	11 43	13 36	15 35	17 45	18
19	20 6	22 11	23 55	1 49	3 44	5 51	7 54	9 54	11 46	13 40	15 39	17 49	19
20	20 10	22 15	23 59	1 52	3 48	5 55	7 58	9 58	11 50	13 44	15 43	17 54	20
21	20 14	22 19	0 3	1 56	3 52	5 59	8 2	10 1	11 54	13 47	15 47	17 58	21
22	20 19	22 23	0 6	2 0	3 56	6 3	8 7	10 5	11 57	13 51	15 52	18 2	22
23	20 23	22 26	0 10	2 3	4 0	6 7	8 10	10 9	12 1	13 55	15 56	18 7	23
24	20 27	22 30	0 13	2 7	4 4	6 12	8 14	10 12	12 4	13 59	16 0	18 11	24
25	20 31	22 34	0 17	2 11	4 8	6 16	8 18	10 16	12 8	14 3	16 4	18 16	25
26	20 35	22 38	0 21	2 15	4 12	6 20	8 22	10 20	12 12	14 7	16 9	18 20	26
27	20 40	22 42	0 24	2 19	4 16	6 24	8 26	10 23	12 15	14 10	16 13	18 25	27
28	20 44	22 45	0 28	2 22	4 20	6 28	8 30	10 27	12 19	14 14	16 17	18 29	28
29	20 48		0 32	2 26	4 24	6 32	8 34	10 31	12 22	14 18	16 21	18 34	29
30	20 52		0 35	2 30	4 28	6 37	8 38	10 34	12 26	14 22	16 26	18 38	30
31	20 56		0 39		4 32		8 42	10 38				18 42	31

This Table is sufficiently exact for finding, when any Star comes to the Meridian, in order to obtain the Latitude; but in all Calculations for determining the Longitude by Celestial Observations, the Sun's Right Ascension and Declination must be taken out of the Nautical Almanac, as they are there calculated to a greater Degree of Accuracy.

A Table of the Right Ascension and Declination of some of the principal fixed Stars adapted to the Year 1775, with their Annual Variation,

Names of the Stars.	Mag.	Ri. Ascen up Time.			Ann. Vari.	Declination				Ann. Var.	
		H. M. S.	S. T.	°		'	"	S.			
Algenib, in the Wing of Pegasus	2	0	1	41	3	8	13	55	57	N	20 a
Schedar, in the Breast of Cassiopeæ	3	0	25	50	3	30	55	14	21		20 a
Pole Star, in the Tail of the Little Bear	2	0	46	53	10	5	88	6	14		19 a
Achenar, the Spring of the River Eridanus	1	1	28	30	2	26	56	23	8		18 f
Almaack, in the Left Foot of Andromeda	2	1	50	10	3	61	41	14	26		18 a
Argol, in the Head of Medusa	2	2	53	56	3	84	40	4	24		15 a
Pleiades, vulgo 7 Stars, in the Neck of the Bull	3	3	34	7	3	54	23	23	36		12 a
Aldebaran, South Eye of the Bull	1	4	23	2	3	43	16	2	32		8 a
Capella, in the Left Shoulder of Auriga	1	5	0	6	4	40	45	44	49		5 a
Rigel, the bright Foot of Orion	1	5	2	41	3	0	8	28	33	S.	5 f
The Eastern Shoulder of Orion, Betelgeuse	1	5	43	0	3	3	7	20	49	N	2 a
Canopus, bright Star in Poop of Ship Argo	1	6	18	57	1	3	52	34	47	S.	1 a
Sirius, bright Star in Great Dog's Mouth	1	6	35	16	4	40	16	24	5		3 a
Castor, in the Head of Northern Twin	2	7	18	48	4	0	32	21	40	N	7 f
Procyon, in the Little Dog	1	7	26	23	3	12	5	47	38		7 f
Pollux, in the Head of the Southern Twin	2	7	30	10	3	75	28	33	10		8 f
Cor Hydræ, or Alphard	2	9	16	32	2	96	7	41	30	S.	15 a
Regulus, the Lion's Heart	1	9	55	12	13	24	13	3	32	N	17 f
Dubhe, the Northernmost Pointer in the Great Bear	2	10	48	14	3	89	62	57	38		19 f
The Southernmost Star of Croifers, Foot of the Crofs	1	12	14	17	3	22	61	51	7	S.	20 a
Spica Virginis	1	13	13	21	3	15	9	58	47		19 a
The Westernmost Foot of Centaur	1	14	24	40	4	41	59	53	55		16 a
Arcturus in Bootes	1	14	4	40	2	82	20	22	14	N	17 a
Antares, or Scorpion's Heart	1	16	15	38	3	66	25	54	51	S.	9 a
Bright Star of the Harp Lyra	1	18	29	19	2	0	38	35	5	N	2 a
Fomalhaut, in Mouth of Southern Fish	1	22	44	51	3	34	30	48	31	S.	19 a
Markeb in Wing of Pegasus	1	22	53	32	3	0	13	58	27	N	19 a
The Head of Andromeda	2	23	56	48	3	6	27	50	53		20 a
Eridani	1	1	29	11	2	26	58	23	34	S.	18 f
Arietis.	2	1	54	27	3	20	22	23	23	N	18 a
Ceti	2	2	50	32	3	8	3	11	42		15 a
Coronæ	2	15	24	49	2	0	27	29	5		12 f
Segittarius	2	18	8	11	4	0	34	18	0	S.	1 f
Aquila, the Eagle	2	19	39	26	2	91	8	17	13		8 a
Capricorn	3	20	4	45	3	2	13	14	40		11 f
Mirach, in Andromeda Girdle	2	0	57	10	3	29	34	25	21		19 a
The bright Star in the Oars, of the Ship Argo	1	9	10	40	0	75	68	47	53		15 a
The bright Star in the Foot Libræ	1	14	24	40	4	41	59	53	55		16 a
Algenib, the bright Star in Perseus	2	3	8	22	4	19	49	2	30		14 a

Note, (a) being set after any Second and Tenth, shews that they are to be added to every succeeding Year after 1775; and (s) shews that they are to be subtracted. As the Alteration of Declination, &c. is so very small, this Table will do for several Years without any sensible Error.

It is obvious, that by the Sun's Annual Motion, he is perpetually changing his Declination and Right Ascension, which is set down in the preceding Table for the Moon of every Day at London; and may be reduced to any other Time or Meridian, as has been already shewn in finding the Longitude.

By the Procession of the Equinoxes, the fixed Stars are continually altering their Longitudes, Right Ascensions, and Declinations; the Alteration in Longitude is about 50 Seconds every Year; the Alteration in Right Ascension and Declination of some of the principal fixed Stars, are set down in the preceding Table for 1775; and their Annual Variation, which being applied to the Right Ascension and Declination in the Table, by Addition or Subtraction, gives the Right Ascension and Declination for any succeeding Years.

The Right Ascension of the Sun, Moon, or Stars, is the Number of Degrees of the Equinoctial that comes to the Meridian with them, counted from the first Point of Aries.

The Use of the Tables of the Right Ascension of the Sun and Star, is to find the Time when any Star culminates, or is upon the Meridian on a Given Day.

R U L E.

Look for the Right Ascension of the Sun and Star in the preceding Tables, and subtract the Sun's Right Ascension from the Star's; but if the Sun's Right Ascension be greatest, add 24 Hours to the Star's Right Ascension, and then subtract the Sun's from it, the Remainder will be the Time of the Star's coming to the Meridian Afternoon.

When the Sun's Right Ascension is least, the Star comes to the Meridian in the Afternoon, but before Noon when the Sun's is greatest.

E X A M P L E I.

At what Time will the Star Arcturus be on the Meridian of London, December 1?

	H. M.
Arcturus's Right Ascension	14 5
Sun's Right Ascension	— 16 30

The Star comes to the Meridian in the Morning } 2 25

That is, the Star Arcturus will be upon the Meridian of London 25 Minutes after Two o'Clock in the Morning.

E X A M P L E II.

At what Time will the Star Virgin's Spike be on the Meridian of London, September 1?

	H. M.
Spica Virginis's Right Ascension	13 10
Sun's Right Ascension	— 10 42

The Star culminates Afternoon 2 31

So the Star, Virgin's Spike, comes to the Meridian at London 31 Minutes after Two in the Afternoon.

To find what Star will come upon the Meridian at any Given Time.

R U L E.

Add the Time from Noon to the Right Ascension of the Sun, the Sum will be the Right Ascension of the Star required to be known; with which, enter the Table of the Star's Right Ascension, and find what Star's Right Ascension agrees with, or comes the nearest to it, and that is the Star required.

E X A M P L E I.

I would know what Star would be on the Meridian of London about Ten at Night, January 25.

	H. M.
Sun's Ri. Ascen. Jan. 25, at Noon,	20 31
And for 10 Hours more	— 0 2
Given Time 10 Hours P. M.	10 0

Sub. 30 33
24 0

Answers to Sirius

6 33

E X A M P L E II.

What Star will be upon the Meridian of London 30 Minutes past Four in the Morning, May 10?

	H. M.
Sun's Ri. Ascen. May 9, at Noon,	3 5
And for 16 Hours more	— 0 3
Given Time 16h. 30m. P. M.	16 30

Right Ascension of Mid Heaven 19 38
Answers nearly to Aquila.

Difference of Latitude and Departure for $\frac{1}{4}$ Point.

Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.
1	01,0	00,0	61	60,9	03,0	121	120,9	05,9	181	180,8	08,9	241	240,7	11,8
2	02,0	00,1	62	61,9	03,0	22	121,9	06,0	82	181,8	08,9	42	241,7	11,9
3	03,0	00,1	63	62,9	03,1	23	122,9	06,0	83	182,8	09,0	43	242,7	11,9
4	04,0	00,2	64	63,9	03,1	24	123,9	06,1	84	183,8	09,0	44	243,7	12,0
5	05,0	00,2	65	64,9	03,2	25	124,9	06,1	85	184,8	09,1	45	244,7	12,0
6	06,0	00,3	66	65,9	03,2	26	125,8	06,2	86	185,8	09,1	46	245,7	12,1
7	07,0	00,3	67	66,9	03,3	27	126,8	06,2	87	186,8	09,2	47	246,7	12,1
8	08,0	00,4	68	67,9	03,3	28	127,8	06,3	88	187,8	09,2	48	247,7	12,2
9	09,0	00,4	69	68,9	03,4	29	128,8	06,3	89	188,8	09,3	49	248,7	12,2
10	10,0	00,5	70	69,9	03,4	30	129,8	06,4	90	189,8	09,3	50	249,7	12,3
11	11,0	00,5	71	70,9	03,5	131	130,8	06,4	191	190,8	09,4	251	250,7	12,3
12	12,0	00,6	72	71,9	03,5	32	131,8	06,5	92	191,8	09,4	52	251,7	12,4
13	13,0	00,6	73	72,9	03,6	33	132,8	06,5	93	192,8	09,5	53	252,7	12,4
14	14,0	00,7	74	73,9	03,6	34	133,8	06,6	94	193,8	09,5	54	253,7	12,5
15	15,0	00,7	75	74,9	03,7	35	134,8	06,6	95	194,8	09,6	55	254,7	12,5
16	16,0	00,8	76	75,9	03,7	36	135,8	06,7	96	195,8	09,6	56	255,7	12,6
17	17,0	00,8	77	76,9	03,8	37	136,8	06,7	97	196,8	09,7	57	256,7	12,6
18	18,0	00,9	78	77,9	03,8	38	137,8	06,8	98	197,8	09,7	58	257,7	12,7
19	19,0	00,9	79	78,9	03,9	39	138,8	06,8	99	198,8	09,8	59	258,7	12,7
20	20,0	01,0	80	79,9	03,9	40	139,8	06,9	200	199,8	09,8	60	259,7	12,8
21	21,0	01,0	81	80,9	04,0	141	140,8	06,9	201	200,8	09,9	261	260,7	12,8
22	22,0	01,1	82	81,9	04,0	42	141,8	07,0	02	201,8	09,9	62	261,7	12,9
23	23,0	01,1	83	82,9	04,1	43	142,8	07,0	03	202,8	10,0	63	262,7	12,9
24	24,0	01,2	84	83,9	04,1	44	143,8	07,1	04	203,8	10,0	64	263,7	13,0
25	25,0	01,2	85	84,9	04,2	45	144,8	07,1	05	204,8	10,1	65	264,7	13,0
26	26,0	01,3	86	85,9	04,2	46	145,8	07,2	06	205,8	10,1	66	265,7	13,1
27	27,0	01,3	87	86,9	04,3	47	146,8	07,2	07	206,8	10,2	67	266,7	13,1
28	28,0	01,4	88	87,9	04,3	48	147,8	07,3	08	207,8	10,2	68	267,7	13,2
29	29,0	01,4	89	88,9	04,4	49	148,8	07,3	09	208,7	10,3	69	268,7	13,2
30	30,0	01,5	90	89,9	04,4	50	149,8	07,4	10	209,7	10,3	70	269,7	13,3
31	31,0	01,5	91	90,9	04,5	151	150,8	07,4	211	210,7	10,4	271	270,7	13,3
32	32,0	01,6	92	91,9	04,5	52	151,8	07,5	12	211,7	10,4	72	271,7	13,4
33	33,0	01,6	93	92,9	04,6	53	152,8	07,5	13	212,7	10,5	73	272,7	13,4
34	34,0	01,7	94	93,9	04,6	54	153,8	07,6	14	213,7	10,5	74	273,7	13,5
35	35,0	01,7	95	94,9	04,7	55	154,8	07,6	15	214,7	10,6	75	274,7	13,5
36	36,0	01,8	96	95,9	04,7	56	155,8	07,7	16	215,7	10,6	76	275,7	13,6
37	37,0	01,8	97	96,9	04,8	57	156,8	07,7	17	216,7	10,7	77	276,7	13,6
38	38,0	01,9	98	97,9	04,8	58	157,8	07,8	18	217,7	10,7	78	277,7	13,7
39	39,0	01,9	99	98,9	04,9	59	158,8	07,8	19	218,7	10,8	79	278,7	13,7
40	40,0	02,0	100	99,9	04,9	60	159,8	07,9	20	219,7	10,8	80	279,7	13,8
41	41,0	02,0	101	100,9	05,0	161	160,8	07,9	221	220,7	10,9	281	280,7	13,8
42	41,9	02,1	02	101,9	05,0	62	161,8	08,0	22	221,7	10,9	82	281,7	13,9
43	42,9	02,1	03	102,9	05,1	63	162,8	08,0	23	222,7	11,0	83	282,7	13,9
44	43,9	02,2	04	103,9	05,1	64	163,8	08,1	24	223,7	11,0	84	283,7	14,0
45	44,9	02,2	05	104,9	05,2	65	164,8	08,1	25	224,7	11,1	85	284,7	14,0
46	45,9	02,3	06	105,9	05,2	66	165,8	08,2	26	225,7	11,1	86	285,7	14,1
47	46,9	02,3	07	106,9	05,3	67	166,8	08,2	27	226,7	11,2	87	286,7	14,1
48	47,9	02,4	08	107,9	05,3	68	167,8	08,3	28	227,7	11,2	88	287,7	14,2
49	48,9	02,4	09	108,9	05,4	69	168,8	08,3	29	228,7	11,3	89	288,7	14,2
50	49,9	02,5	10	109,9	05,4	70	169,8	08,4	30	229,7	11,3	90	289,7	14,3
51	50,9	02,5	111	110,9	05,5	171	170,8	08,4	231	230,7	11,4	291	290,7	14,3
52	51,9	02,6	12	111,9	05,5	72	171,8	08,5	32	231,7	11,4	292	291,6	14,4
53	52,9	02,6	13	112,9	05,5	73	172,8	08,5	33	232,7	11,5	293	292,6	14,4
54	53,9	02,7	14	113,9	05,6	74	173,8	08,5	34	233,7	11,5	294	293,6	14,5
55	54,9	02,7	15	114,9	05,6	75	174,8	08,6	35	234,7	11,5	295	294,6	14,5
56	55,9	02,8	16	115,9	05,7	76	175,8	08,6	36	235,7	11,6	296	295,6	14,5
57	56,9	02,8	17	116,9	05,7	76	176,8	08,7	37	236,7	11,6	297	296,6	14,6
58	57,9	02,9	18	117,9	05,8	77	177,8	08,7	38	237,7	11,7	298	297,6	14,6
59	58,9	02,9	19	118,9	05,9	79	178,8	08,8	39	238,7	11,7	299	298,6	14,7
60	59,9	02,9	20	119,9	05,9	80	179,8	08,8	40	239,7	11,8	300	299,6	14,7
Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.

[a]

for $7\frac{1}{4}$ Points.

Difference of Latitude and Departure for $\frac{1}{2}$ Point.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01,0	00,1	61	60,7	06,0	121	120,4	11,8	181	180,1	17,7	241	239,8	23,6
2	02,0	00,2	62	61,7	06,1	22	121,4	11,9	82	181,1	17,8	42	240,8	23,7
3	03,0	00,3	63	62,7	06,2	23	122,4	12,0	83	182,1	17,9	43	241,8	23,8
4	04,0	00,4	64	63,7	06,3	24	123,4	12,1	84	183,1	18,0	44	242,8	23,9
5	05,0	00,5	65	64,7	06,4	25	124,4	12,2	85	184,1	18,1	45	243,8	24,0
6	06,0	00,6	66	65,7	06,5	26	125,4	12,3	86	185,1	18,2	46	244,8	24,1
7	07,0	00,7	67	66,7	06,6	27	126,4	12,4	87	186,1	18,3	47	245,8	24,2
8	08,0	00,8	68	67,7	06,7	28	127,4	12,5	88	187,1	18,4	48	246,8	24,3
9	09,0	00,9	69	68,7	06,7	29	128,4	12,6	89	188,1	18,5	49	247,8	24,4
10	10,0	01,0	70	69,7	06,8	30	129,4	12,7	90	189,1	18,6	50	248,8	24,5
11	10,9	01,1	71	70,7	06,9	131	130,4	12,8	191	190,1	18,7	251	249,8	24,6
12	11,9	01,2	72	71,7	07,0	32	131,4	12,9	92	191,1	18,8	52	250,8	24,7
13	12,9	01,3	73	72,6	07,1	33	132,4	13,0	93	192,1	18,9	53	251,8	24,8
14	13,9	01,4	74	73,6	07,2	34	133,4	13,1	94	193,1	19,0	54	252,8	24,9
15	14,9	01,5	75	74,6	07,3	35	134,4	13,2	95	194,1	19,1	55	253,8	25,0
16	15,9	01,6	76	75,6	07,4	36	135,3	13,3	96	195,1	19,2	56	254,8	25,1
17	16,9	01,7	77	76,6	07,5	37	136,3	13,4	97	196,1	19,3	57	255,8	25,2
18	17,9	01,8	78	77,6	07,6	38	137,3	13,5	98	197,0	19,4	58	256,8	25,3
19	18,9	01,9	79	78,6	07,7	39	138,3	13,6	99	198,0	19,5	59	257,8	25,4
20	19,9	02,0	80	79,6	07,8	40	139,3	13,7	200	199,0	19,6	60	258,8	25,5
21	20,9	02,1	81	80,6	07,9	141	140,3	13,8	201	200,0	19,7	261	259,7	25,6
22	21,9	02,2	82	81,6	08,0	42	141,3	13,9	02	201,0	19,8	62	260,7	25,7
23	22,9	02,2	83	82,6	08,1	43	142,3	14,0	03	202,0	19,9	63	261,7	25,8
24	23,9	02,3	84	83,6	08,2	44	143,3	14,1	04	203,0	20,0	64	262,7	25,9
25	24,9	02,4	85	84,6	08,3	45	144,3	14,2	05	204,0	20,1	65	263,7	26,0
26	25,9	02,5	86	85,6	08,4	46	145,3	14,3	06	205,0	20,2	66	264,7	26,1
27	26,9	02,6	87	86,6	08,5	47	146,3	14,4	07	206,0	20,2	67	265,7	26,2
28	27,9	02,7	88	87,6	08,6	48	147,3	14,5	08	207,0	20,3	68	266,7	26,3
29	28,9	02,8	89	88,6	08,7	49	148,3	14,6	09	208,0	20,4	69	267,7	26,4
30	29,9	02,9	90	89,6	08,8	50	149,3	14,7	10	209,0	20,5	70	268,7	26,5
31	30,9	03,0	91	90,6	08,9	151	150,3	14,8	211	210,0	20,6	271	269,7	26,6
32	31,8	03,1	92	91,6	09,0	52	151,3	14,9	12	211,0	20,7	72	270,7	26,7
33	32,8	03,2	93	92,6	09,1	53	152,3	15,0	13	212,0	20,8	73	271,7	26,8
34	33,8	03,3	94	93,5	09,2	54	153,3	15,1	14	213,0	20,9	74	272,7	26,9
35	34,8	03,4	95	94,5	09,3	55	154,3	15,2	15	214,0	21,0	75	273,7	27,0
36	35,8	03,5	96	95,5	09,4	56	155,3	15,3	16	215,0	21,1	76	274,7	27,1
37	36,8	03,6	97	96,5	09,5	57	156,2	15,4	17	216,0	21,2	77	275,7	27,2
38	37,8	03,7	98	97,5	09,6	58	157,2	15,4	18	217,0	21,3	78	276,7	27,3
39	38,8	03,8	99	98,5	09,7	59	158,2	15,6	19	217,9	21,4	79	277,7	27,4
40	39,8	03,9	100	99,5	09,8	60	159,2	15,7	20	218,9	21,5	80	278,7	27,5
41	40,8	04,0	101	100,5	09,9	161	160,2	15,7	221	219,9	21,6	281	279,6	27,6
42	41,8	04,1	02	101,5	10,0	62	161,2	15,8	22	220,9	21,7	82	280,6	27,7
43	42,8	04,2	03	102,5	10,1	63	162,2	15,9	23	221,9	21,8	83	281,6	27,8
44	43,8	04,3	04	103,5	10,2	64	163,2	16,0	24	222,9	21,9	84	282,6	27,9
45	44,8	04,4	05	104,5	10,3	65	164,2	16,1	25	223,9	22,0	85	283,6	28,0
46	45,8	04,5	06	105,5	10,4	66	165,2	16,2	26	224,9	22,1	86	284,6	28,1
47	46,8	04,6	07	106,5	10,5	67	166,2	16,3	27	225,9	22,2	87	285,6	28,2
48	47,8	04,7	08	107,5	10,6	68	167,2	16,4	28	226,9	22,3	88	286,6	28,3
49	48,8	04,8	09	108,5	10,7	69	168,2	16,5	29	227,9	22,4	89	287,6	28,4
50	49,8	04,9	10	109,5	10,8	70	169,2	16,6	30	228,9	22,5	90	288,6	28,5
51	50,8	05,0	111	110,5	10,9	171	170,2	16,7	231	229,9	22,6	291	289,6	28,6
52	51,8	05,1	12	111,5	11,0	72	171,2	16,8	32	230,9	22,7	92	290,6	28,7
53	52,7	05,2	13	112,5	11,1	73	172,2	16,9	33	231,9	22,8	93	291,6	28,8
54	53,7	05,3	14	113,5	11,2	74	173,2	17,0	34	232,9	22,9	94	292,6	28,9
55	54,7	05,4	15	114,4	11,3	75	174,2	17,1	35	233,9	23,0	95	293,6	29,0
56	55,7	05,5	16	115,4	11,4	76	175,2	17,2	36	234,9	23,1	96	294,6	29,1
57	56,7	05,6	17	116,4	11,5	77	176,2	17,3	37	235,9	23,2	97	295,6	29,2
58	57,7	05,7	18	117,4	11,6	78	177,1	17,4	38	236,9	23,3	98	296,6	29,2
59	58,7	05,8	19	118,4	11,7	79	178,1	17,5	39	237,9	23,4	99	297,6	29,3
60	59,7	05,9	20	119,4	11,8	80	179,1	17,6	40	238,9	23,5	300	298,6	29,4
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for $7\frac{1}{2}$ Points.

Difference of Latitude and Departure for $\frac{1}{4}$ Points.

Dift.	Lat.	Dep.	Dift.	Lat.	Dep.	Dift.	Lat.	D. p.	Dift.	Lat.	Dep.	Dift.	Lat.	Dep.
1	01,0	00,1	61	60,3	08,9	121	119,7	17,7	181	179,0	26,5	241	238,4	35,3
2	02,0	00,3	62	61,3	09,1	22	120,7	17,8	82	180,0	26,7	42	239,4	35,5
3	03,0	00,4	63	62,3	09,2	23	121,7	18,0	83	181,0	26,8	43	240,4	35,6
4	04,0	00,6	64	63,3	09,4	24	122,7	18,2	84	182,0	27,0	44	241,3	35,8
5	04,9	00,7	65	64,3	09,5	25	123,6	18,3	85	183,0	27,1	45	242,3	35,9
6	05,9	00,9	66	65,3	09,7	26	124,6	18,5	86	184,0	27,3	46	243,3	36,1
7	06,9	01,0	67	66,3	09,8	27	125,6	18,6	87	185,0	27,4	47	244,3	36,2
8	07,9	01,2	68	67,3	10,0	28	126,6	18,8	88	186,0	27,6	48	245,3	36,4
9	08,9	01,3	69	68,2	10,1	29	127,6	18,9	89	186,9	27,7	49	246,3	36,5
10	09,9	01,5	70	69,2	10,3	30	128,6	19,1	90	187,9	27,9	50	247,3	36,7
11	10,9	01,6	71	70,2	10,4	131	129,6	19,2	191	188,9	28,0	251	248,3	36,8
12	11,9	01,8	72	71,2	10,6	32	130,6	19,4	92	189,9	28,2	52	249,3	37,0
13	12,9	01,9	73	72,2	10,7	33	131,6	19,5	93	190,9	28,3	53	250,2	37,1
14	13,8	02,1	74	73,2	10,9	34	132,5	19,6	94	191,9	28,5	54	251,2	37,3
15	14,8	02,2	75	74,2	11,0	35	133,5	19,8	95	192,9	28,6	55	252,2	37,4
16	15,8	02,3	76	75,2	11,1	36	134,5	19,9	96	193,9	28,7	56	253,2	37,5
17	16,8	02,5	77	76,2	11,3	37	135,5	20,1	97	194,9	28,9	57	254,2	37,7
18	17,8	02,6	78	77,1	11,4	38	136,5	20,2	98	195,8	29,0	58	255,2	37,8
19	18,8	02,8	79	78,1	11,6	39	137,5	20,4	99	196,8	29,2	59	256,2	38,0
20	19,8	02,9	80	79,1	11,7	40	138,5	20,5	200	197,8	29,3	60	257,2	38,1
21	20,8	03,1	81	80,1	11,9	141	139,5	20,7	201	198,8	29,5	261	258,2	38,3
22	21,8	03,2	82	81,1	12,0	42	140,5	20,8	02	199,8	29,6	62	259,1	38,4
23	22,7	03,4	83	82,1	12,2	43	141,4	21,0	03	200,8	29,8	63	260,1	38,6
24	23,7	03,5	84	83,1	12,3	44	142,4	21,1	04	201,8	29,9	64	261,1	38,7
25	24,7	03,7	85	84,1	12,5	45	143,4	21,3	05	202,8	30,1	65	262,1	38,9
26	25,7	03,8	86	85,1	12,6	46	144,4	21,4	06	203,8	30,2	66	263,1	39,0
27	26,7	04,0	87	86,1	12,8	47	145,4	21,6	07	204,7	30,4	67	264,1	39,2
28	27,7	04,1	88	87,0	12,9	48	146,4	21,7	08	205,7	30,5	68	265,1	39,3
29	28,7	04,3	89	88,0	13,0	49	147,4	21,8	09	206,7	30,6	69	266,1	39,5
30	29,7	04,4	90	89,0	13,2	50	148,4	22,0	10	207,7	30,8	70	267,1	39,6
31	30,7	04,5	91	90,0	13,3	151	149,4	22,1	211	208,7	30,9	271	268,1	39,7
32	31,7	04,7	92	91,0	13,5	52	150,3	22,3	12	209,7	31,1	72	269,0	39,9
33	32,6	04,8	93	92,0	13,6	53	151,3	22,4	13	210,7	31,2	73	270,0	40,0
34	33,6	05,0	94	93,0	13,8	54	152,3	22,6	14	211,7	31,4	74	271,0	40,2
35	34,6	05,1	95	94,0	13,9	55	153,3	22,7	15	212,7	31,5	75	272,0	40,3
36	35,6	05,3	96	95,0	14,1	56	154,3	22,9	16	213,7	31,7	76	273,0	40,5
37	36,6	05,4	97	95,9	14,2	57	155,3	23,0	17	214,6	31,8	77	274,0	40,6
38	37,6	05,6	98	96,9	14,4	58	156,3	23,2	18	215,6	32,0	78	275,0	40,8
39	38,6	05,7	99	97,9	14,5	59	157,3	23,3	19	216,6	32,1	79	276,0	40,9
40	39,6	05,9	100	98,9	14,7	60	158,3	23,5	20	217,6	32,3	80	277,0	41,1
41	40,6	06,0	101	99,9	14,8	161	159,2	23,6	221	218,6	32,4	281	277,9	41,2
42	41,5	06,2	02	100,9	15,0	62	160,2	23,8	22	219,6	32,6	82	278,9	41,4
43	42,5	06,3	03	101,9	15,1	63	161,2	23,9	23	220,6	32,7	83	279,9	41,5
44	43,5	06,5	04	102,9	15,3	64	162,2	24,0	24	221,6	32,8	84	280,9	41,6
45	44,5	06,6	05	103,9	15,4	65	163,2	24,2	25	222,6	33,0	85	281,9	41,8
46	45,5	06,7	06	104,8	15,5	66	164,2	24,3	26	223,5	33,1	86	282,9	41,9
47	46,5	06,9	07	105,8	15,7	67	165,2	24,5	27	224,5	33,3	87	283,9	42,1
48	47,5	07,0	08	106,8	15,8	68	166,2	24,6	28	225,5	33,4	88	284,9	42,2
49	48,5	07,2	09	107,8	16,0	69	167,2	24,8	29	226,5	33,6	89	285,9	42,4
50	49,5	07,3	10	108,8	16,1	70	168,1	24,9	30	227,5	33,7	90	286,8	42,5
51	50,4	07,5	111	109,8	16,3	171	169,1	25,1	231	228,5	33,9	291	287,8	42,7
52	51,4	07,6	12	110,8	16,4	72	170,1	25,2	32	229,5	34,0	92	288,8	42,8
53	52,4	07,8	13	111,8	16,6	73	171,1	25,4	33	230,5	34,2	93	289,8	43,0
54	53,4	07,9	14	112,8	16,7	74	172,1	25,5	34	231,5	34,3	94	290,8	43,1
55	54,4	08,1	15	113,7	16,9	75	173,1	25,7	35	232,4	34,5	95	291,8	43,3
56	55,4	08,2	16	114,7	17,0	76	174,1	25,8	36	233,4	34,6	96	292,8	43,4
57	56,4	08,4	17	115,7	17,2	77	175,1	26,0	37	234,4	34,8	97	293,8	43,6
58	57,4	08,5	18	116,7	17,3	78	176,1	26,1	38	235,4	34,9	98	294,8	43,7
59	58,4	08,7	19	117,7	17,5	79	177,1	26,3	39	236,4	35,0	99	295,7	43,8
60	59,3	08,8	20	118,7	17,6	80	178,0	26,4	40	237,4	35,2	300	296,7	44,0
Dift.	Dep.	Lat.	Dift.	Dep.	Lat.	Dift.	Dep.	Lat.	Dift.	Dep.	Lat.	Dift.	Dep.	Lat.

Difference of Latitude and Departure for 1 Point.

Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.
1	01,0	00,2	61	59,8	11,9	121	118,7	23,6	181	177,5	35,3	241	236,3	47,0
2	02,0	00,4	62	60,8	12,1	22	119,6	23,8	82	178,5	35,5	42	237,3	47,2
3	03,0	00,6	63	61,8	12,3	23	120,6	24,0	83	179,5	35,7	43	238,3	47,4
4	03,9	00,8	64	62,8	12,5	24	121,6	24,2	84	180,4	35,9	44	239,3	47,6
5	04,9	01,0	65	63,7	12,7	25	122,6	24,4	85	181,4	36,1	45	240,3	47,8
6	05,9	01,2	66	64,7	12,9	26	123,6	24,6	86	182,4	36,3	46	241,2	48,0
7	06,9	01,4	67	65,7	13,1	27	124,5	24,8	87	183,4	36,5	47	242,2	48,2
8	07,8	01,6	68	66,7	13,3	28	125,5	25,0	88	184,4	36,7	48	243,2	48,4
9	08,8	01,8	69	67,7	13,5	29	126,5	25,2	89	185,3	36,9	49	244,2	48,6
10	09,8	02,0	70	68,7	13,7	30	127,5	25,4	90	186,3	37,1	50	245,2	48,8
11	10,8	02,1	71	69,6	13,9	31	128,5	25,6	91	187,3	37,3	51	246,1	49,0
12	11,8	02,3	72	70,6	14,0	32	129,5	25,8	92	188,3	37,5	52	247,1	49,2
13	12,7	02,5	73	71,6	14,2	33	130,4	26,0	93	189,3	37,7	53	248,1	49,4
14	13,7	02,7	74	72,6	14,4	34	131,4	26,1	94	190,2	37,9	54	249,1	49,6
15	14,7	02,9	75	73,6	14,6	35	132,4	26,3	95	191,2	38,0	55	250,1	49,8
16	15,7	03,1	76	74,5	14,8	36	133,4	26,5	96	192,2	38,2	56	251,1	50,0
17	16,7	03,3	77	75,5	15,0	37	134,4	26,7	97	193,2	38,4	57	252,1	50,1
18	17,7	03,5	78	76,5	15,2	38	135,3	26,9	98	194,2	38,6	58	253,0	50,3
19	18,6	03,7	79	77,5	15,4	39	136,3	27,1	99	195,2	38,8	59	254,0	50,5
20	19,6	03,9	80	78,5	15,6	40	137,3	27,3	200	196,1	39,0	60	255,0	50,7
21	20,6	04,1	81	79,4	15,8	41	138,3	27,5	201	197,1	39,2	61	256,0	50,9
22	21,6	04,3	82	80,4	16,0	42	139,3	27,7	02	198,1	39,4	62	256,9	51,1
23	22,6	04,5	83	81,4	16,2	43	140,2	27,9	03	199,1	39,6	63	257,9	51,3
24	23,5	04,7	84	82,4	16,4	44	141,2	28,1	04	200,1	39,8	64	258,9	51,5
25	24,5	04,9	85	83,4	16,6	45	142,2	28,3	05	201,0	40,0	65	259,9	51,7
26	25,5	05,1	86	84,3	16,8	46	143,2	28,5	06	202,0	40,2	66	260,9	51,9
27	26,5	05,3	87	85,3	17,0	47	144,2	28,7	07	203,0	40,4	67	261,8	52,1
28	27,5	05,5	88	86,3	17,2	48	145,1	28,9	08	204,0	40,6	68	262,8	52,3
29	28,4	05,7	89	87,3	17,4	49	146,1	29,1	09	205,0	40,8	69	263,8	52,5
30	29,4	05,9	90	88,3	17,6	50	147,1	29,3	10	205,9	41,0	70	264,8	52,7
31	30,4	06,0	91	89,2	17,8	51	148,1	29,5	211	206,9	41,2	71	265,8	52,9
32	31,4	06,2	92	90,2	18,0	52	149,1	29,7	12	207,9	41,4	72	266,7	53,1
33	32,4	06,4	93	91,2	18,1	53	150,0	29,9	13	208,9	41,6	73	267,7	53,3
34	33,3	06,6	94	92,2	18,3	54	151,0	30,0	14	209,9	41,8	74	268,7	53,5
35	34,3	06,8	95	93,2	18,5	55	152,0	30,2	15	210,8	42,0	75	269,7	53,7
36	35,3	07,0	96	94,1	18,7	56	153,0	30,4	16	211,8	42,1	76	270,7	53,9
37	36,3	07,2	97	95,1	18,9	57	154,0	30,6	17	212,8	42,3	77	271,6	54,0
38	37,3	07,4	98	96,1	19,1	58	154,9	30,8	18	213,8	42,5	78	272,6	54,2
39	38,2	07,6	99	97,1	19,3	59	155,9	31,0	19	214,8	42,7	79	273,6	54,4
40	39,2	07,8	100	98,1	19,5	60	156,9	31,2	20	215,7	42,9	80	274,6	54,6
41	40,2	08,0	101	99,1	19,7	61	157,9	31,4	221	216,7	43,1	281	275,6	54,8
42	41,2	08,2	02	100,0	19,9	62	158,9	31,6	22	217,7	43,3	82	276,5	55,0
43	42,2	08,4	03	101,0	20,1	63	159,8	31,8	23	218,7	43,5	83	277,5	55,2
44	43,2	08,6	04	102,0	20,3	64	160,8	32,0	24	219,7	43,7	84	278,5	55,4
45	44,1	08,8	05	103,0	20,5	65	161,8	32,2	25	220,6	43,9	85	279,5	55,6
46	45,1	09,0	06	104,0	20,7	66	162,8	32,4	26	221,6	44,1	86	280,5	55,8
47	46,1	09,2	07	104,9	20,9	67	163,8	32,6	27	222,6	44,3	87	281,5	56,0
48	47,1	09,6	08	105,9	21,1	68	164,7	32,8	28	223,6	44,5	88	282,4	56,2
49	48,1	09,6	09	106,9	21,3	69	165,7	33,0	29	224,6	44,7	89	283,4	56,4
50	49,0	09,8	10	107,9	21,5	70	166,7	33,2	30	225,6	44,9	90	284,4	56,6
51	50,0	10,0	111	108,9	21,7	171	167,7	33,4	231	226,5	45,1	291	285,4	56,8
52	51,0	10,1	12	109,8	21,9	72	168,7	33,6	32	227,5	45,3	92	286,4	57,0
53	52,0	10,3	13	110,8	22,0	73	169,7	33,8	33	228,5	45,5	93	287,3	57,2
54	53,0	10,5	14	111,8	22,2	74	170,6	34,0	34	229,5	45,7	94	288,3	57,4
55	53,9	10,7	15	112,8	22,4	75	171,6	34,1	35	230,5	45,9	95	289,3	57,6
56	54,9	10,9	16	113,8	22,6	76	172,6	34,3	36	231,4	46,0	96	290,3	57,8
57	55,9	11,1	17	114,7	22,8	77	173,6	34,5	37	232,4	46,2	97	291,3	58,0
58	56,9	11,3	18	115,7	23,0	78	174,6	34,7	38	233,4	46,4	98	292,2	58,1
59	57,9	11,5	19	116,7	23,2	79	175,5	34,9	39	234,4	46,6	99	293,2	58,3
60	58,8	11,7	20	117,7	23,4	80	176,5	35,1	40	235,4	46,8	300	294,2	58,5
Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.

for 7 Points.

Difference of Latitude and Departure for $1\frac{1}{4}$ Point.

Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.
1	01,0	00,2	61	59,2	14,8	121	117,4	29,4	181	175,6	44,0	241	233,8	58,6			
2	01,9	00,5	62	60,1	15,1	22	118,3	29,6	82	176,5	44,2	42	234,7	58,8			
3	02,9	00,7	63	61,1	15,3	23	119,3	29,9	83	177,5	44,5	43	235,7	59,0			
4	03,9	01,0	64	62,1	15,6	24	120,3	30,1	84	178,5	44,7	44	236,7	59,3			
5	04,9	01,2	65	63,1	15,8	25	121,3	30,4	85	179,5	45,0	45	237,7	59,5			
6	05,8	01,5	66	64,0	16,0	26	122,2	30,6	86	180,4	45,2	46	238,6	59,8			
7	06,8	01,7	67	65,0	16,3	27	123,2	30,9	87	181,4	45,4	47	239,6	60,0			
8	07,8	01,9	68	66,0	16,5	28	124,2	31,1	88	182,4	45,7	48	240,6	60,3			
9	08,7	02,2	69	66,9	16,8	29	125,1	31,3	89	183,3	45,9	49	241,5	60,5			
10	09,7	02,4	70	67,9	17,0	30	126,1	31,6	90	184,3	46,2	50	242,5	60,7			
11	10,7	02,7	71	68,9	17,3	131	127,1	31,8	191	185,3	46,4	251	243,5	61,0			
12	11,6	02,9	72	69,8	17,5	32	128,0	32,1	92	186,2	46,7	52	244,4	61,2			
13	12,6	03,2	73	70,8	17,7	33	129,0	32,3	93	187,2	46,9	53	245,4	61,5			
14	13,6	03,4	74	71,8	18,0	34	130,0	32,6	94	188,2	47,1	54	246,4	61,7			
15	14,6	03,6	75	72,8	18,2	35	131,0	32,8	95	189,2	47,4	55	247,4	62,0			
16	15,5	03,9	76	73,7	18,5	36	131,9	33,0	96	190,1	47,6	56	248,3	62,2			
17	16,5	04,1	77	74,7	18,7	37	132,9	33,3	97	191,1	47,9	57	249,3	62,5			
18	17,5	04,4	78	75,7	19,0	38	133,9	33,5	98	192,1	48,1	58	250,3	62,7			
19	18,4	04,6	79	76,6	19,2	39	134,8	33,8	99	193,0	48,4	59	251,2	62,9			
20	19,4	04,9	80	77,6	19,4	40	135,8	34,0	200	194,0	48,6	60	252,2	63,2			
21	20,4	05,1	81	78,6	19,7	141	136,8	34,3	201	195,0	48,8	261	253,2	63,4			
22	21,3	05,3	82	79,5	19,9	42	137,7	34,5	02	195,9	49,1	62	254,1	63,7			
23	22,3	05,6	83	80,5	20,2	43	138,7	34,7	03	196,9	49,3	63	255,1	63,9			
24	23,3	05,8	84	81,5	20,4	44	139,7	35,0	04	197,9	49,6	64	256,1	64,2			
25	24,3	06,1	85	82,5	20,7	45	140,7	35,2	05	198,9	49,8	65	257,1	64,4			
26	25,2	06,3	86	83,4	20,9	46	141,6	35,5	06	199,8	50,1	66	258,0	64,6			
27	26,2	06,6	87	84,4	21,1	47	142,6	35,7	07	200,8	50,3	67	259,0	64,9			
28	27,2	06,8	88	85,4	21,4	48	143,6	36,0	08	201,8	50,5	68	260,0	65,1			
29	28,1	07,0	89	86,3	21,6	49	144,5	36,2	09	202,7	50,8	69	260,9	65,4			
30	29,1	07,3	90	87,3	21,9	50	145,5	36,5	10	203,7	51,0	70	261,9	65,6			
31	30,1	07,5	91	88,3	22,1	151	146,5	36,7	211	204,7	51,3	271	262,9	65,9			
32	31,0	07,8	92	89,2	22,4	52	147,4	36,9	12	205,6	51,5	72	263,8	66,1			
33	32,0	08,0	93	90,2	22,6	53	148,4	37,2	13	206,6	51,8	73	264,8	66,3			
34	33,0	08,3	94	91,2	22,8	54	149,4	37,4	14	207,6	52,0	74	265,8	66,6			
35	34,0	08,5	95	92,2	23,1	55	150,4	37,7	15	208,6	52,2	75	266,8	66,8			
36	34,9	08,7	96	93,1	23,3	56	151,3	37,9	16	209,5	52,5	76	267,7	67,1			
37	35,9	09,0	97	94,1	23,6	57	152,3	38,2	17	210,5	52,7	77	268,7	67,3			
38	36,9	09,2	98	95,1	23,8	58	153,3	38,4	18	211,5	53,0	78	269,7	67,6			
39	37,8	09,5	99	96,0	24,1	59	154,2	38,6	19	212,4	53,2	79	270,6	67,8			
40	38,8	09,7	100	97,0	24,3	60	155,2	38,9	20	213,4	53,5	80	271,6	68,0			
41	39,8	10,0	101	98,0	24,5	161	156,2	39,1	221	214,4	53,7	281	272,6	68,3			
42	40,7	10,2	02	98,9	24,8	62	157,1	39,4	22	215,3	53,9	82	273,5	68,5			
43	41,7	10,4	03	99,9	25,0	63	158,1	39,6	23	216,3	54,2	83	274,5	68,8			
44	42,7	10,7	04	100,9	25,3	64	159,1	39,9	24	217,3	54,4	84	275,5	69,0			
45	43,7	10,9	05	101,9	25,5	65	160,1	40,1	25	218,3	54,7	85	276,5	69,3			
46	44,6	11,2	06	102,8	25,8	66	161,0	40,3	26	219,2	54,9	86	277,4	69,5			
47	45,6	11,4	07	103,8	26,0	67	162,0	40,6	27	220,2	55,2	87	278,4	69,7			
48	46,6	11,7	08	104,8	26,2	68	163,0	40,8	28	221,2	55,4	88	279,4	70,0			
49	47,5	11,9	09	105,7	26,5	69	163,9	41,1	29	222,1	55,6	89	280,3	70,2			
50	48,5	12,2	10	106,7	26,7	70	164,9	41,3	30	223,1	55,9	90	281,3	70,5			
51	49,5	12,4	111	107,7	27,0	171	165,9	41,6	231	224,1	56,1	291	282,3	70,7			
52	50,4	12,6	12	108,6	27,2	72	166,8	41,8	32	225,0	56,4	92	283,2	71,0			
53	51,4	12,9	13	109,6	27,5	73	167,8	42,0	33	226,0	56,6	93	284,2	71,2			
54	52,4	13,1	14	110,6	27,7	74	168,8	42,3	34	227,0	56,9	94	285,2	71,4			
55	53,4	13,4	15	111,6	27,9	75	169,8	42,5	35	228,0	57,1	95	286,2	71,7			
56	54,3	13,6	16	112,5	28,2	76	170,7	42,8	36	228,9	57,3	96	287,1	71,9			
57	55,3	13,9	17	113,5	28,4	77	171,7	43,0	37	229,9	57,6	97	288,1	72,2			
58	56,3	14,1	18	114,5	28,7	78	172,7	43,3	38	230,9	57,8	98	289,1	72,4			
59	57,2	14,3	19	115,4	28,9	79	173,6	43,5	39	231,8	58,1	99	290,0	72,7			
60	58,2	14,6	20	116,4	29,2	80	174,6	43,7	40	232,8	58,3	300	291,0	72,9			
Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.

for $6\frac{1}{4}$ Points.

Difference of Latitude and Departure for 1 $\frac{1}{2}$ Point.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01,0	00,3	61	58,4	17,7	121	115,8	35,1	181	173,2	52,3	241	230,6	69,9
2	01,9	00,6	62	59,3	18,0	22	116,3	35,4	82	174,2	52,8	42	231,6	70,2
3	02,9	00,9	63	60,3	18,3	23	117,7	35,7	83	175,1	53,1	43	232,5	70,5
4	03,8	01,2	64	61,2	18,6	24	118,7	36,0	84	176,1	53,4	44	233,5	70,8
5	04,8	01,5	65	62,2	18,9	25	119,6	36,3	85	177,0	53,7	45	234,5	71,0
6	05,7	01,7	66	63,2	19,1	26	120,6	36,5	86	178,0	53,9	46	235,4	71,3
7	06,7	02,0	67	64,1	19,4	27	121,5	36,8	87	179,0	54,2	47	236,4	71,6
8	07,7	02,3	68	65,1	19,7	28	122,5	37,1	88	179,9	54,5	48	237,3	71,9
9	08,6	02,6	69	66,0	20,0	9	123,5	37,4	89	180,9	54,8	49	238,3	72,2
10	09,6	02,9	70	67,0	20,3	30	124,4	37,7	90	181,8	55,1	50	239,2	72,5
11	10,5	03,2	71	67,9	20,6	131	125,4	38,0	191	182,8	55,4	251	240,2	72,8
12	11,5	03,5	72	68,9	20,9	32	126,3	38,3	92	183,7	55,7	52	241,2	73,1
13	12,4	03,8	73	69,9	21,2	33	127,3	38,6	93	184,7	56,0	53	242,1	73,4
14	13,4	04,1	74	70,8	21,5	34	128,2	38,9	94	185,7	56,3	54	243,1	73,7
15	14,4	04,4	75	71,8	21,8	35	129,2	39,2	95	186,6	56,6	55	244,0	74,0
16	15,3	04,6	76	72,7	22,0	36	130,2	39,4	96	187,6	56,8	56	245,0	74,2
17	16,3	04,9	77	73,7	22,3	37	131,1	39,7	97	188,5	57,1	57	245,9	74,5
18	17,2	05,2	78	74,6	22,6	38	132,1	40,0	98	189,5	57,4	58	246,9	74,8
19	18,2	05,5	79	75,6	22,9	39	133,0	40,3	99	190,4	57,7	59	247,9	75,1
20	19,1	05,8	80	76,6	23,2	40	134,0	40,6	200	191,4	58,0	60	248,8	75,4
21	20,1	06,1	81	77,5	23,5	141	135,0	40,9	201	192,4	58,3	261	249,8	75,7
22	21,1	06,4	82	78,5	23,8	42	135,9	41,2	202	193,3	58,6	62	250,7	76,0
23	22,0	06,7	83	79,4	24,1	43	136,9	41,5	203	194,3	58,9	63	251,7	76,3
24	23,0	07,0	84	80,4	24,4	44	137,8	41,8	204	195,2	59,2	64	252,6	76,6
25	23,9	07,3	85	81,3	24,7	45	138,8	42,1	205	196,2	59,5	65	253,6	76,9
26	24,9	07,5	86	82,3	24,9	46	139,7	42,3	206	197,1	59,7	66	254,6	77,1
27	25,8	07,8	87	83,3	25,2	47	140,7	42,6	207	198,1	60,0	67	255,5	77,4
28	26,8	08,1	88	84,2	25,5	48	141,6	42,9	208	199,1	60,3	68	256,5	77,7
29	27,8	08,4	89	85,2	25,8	49	142,6	43,2	209	200,0	60,6	69	257,4	78,0
30	28,7	08,7	90	86,1	26,1	50	143,5	43,5	210	201,0	60,9	70	258,4	78,3
31	29,7	09,0	91	87,1	26,4	151	144,5	43,8	211	201,9	61,2	271	259,3	78,6
32	30,6	09,3	92	88,0	26,7	52	145,5	44,1	212	202,9	61,5	72	260,3	78,9
33	31,6	09,6	93	89,0	27,0	53	146,4	44,4	213	203,8	61,8	73	261,3	79,2
34	32,5	09,9	94	90,0	27,3	54	147,4	44,7	214	204,8	62,1	74	262,2	79,5
35	33,5	10,2	95	90,9	27,6	55	148,3	45,0	215	205,8	62,4	75	263,2	79,8
36	34,5	10,4	96	91,9	27,8	56	149,3	45,2	216	206,7	62,6	76	264,1	80,0
37	35,4	10,7	97	92,8	28,1	57	150,2	45,5	217	207,7	62,9	77	265,1	80,3
38	36,4	11,0	98	93,8	28,4	58	151,2	45,8	218	208,6	63,2	78	266,0	80,6
39	37,3	11,3	99	94,7	28,7	59	152,2	46,1	219	209,6	63,5	79	267,0	80,9
40	38,3	11,6	100	95,7	29,0	60	153,1	46,4	220	210,5	63,8	80	268,0	81,2
41	39,2	11,9	01	96,7	29,3	161	154,1	46,7	221	211,5	64,1	281	268,9	81,5
42	40,2	12,2	02	97,6	29,6	62	155,0	47,0	222	212,5	64,4	82	269,9	81,8
43	41,2	12,5	03	98,6	29,9	63	156,0	47,3	223	213,4	64,7	83	270,8	82,1
44	42,1	12,8	04	99,5	30,2	64	156,9	47,6	224	214,4	65,0	84	271,8	82,4
45	43,1	13,1	05	100,5	30,5	65	157,9	47,9	225	215,3	65,3	85	272,7	82,7
46	44,0	13,3	06	101,4	30,7	66	158,8	48,1	226	216,3	65,5	86	273,7	82,9
47	45,0	13,6	07	102,4	31,0	67	159,8	48,4	227	217,2	65,8	87	274,7	83,2
48	45,9	13,9	08	103,4	31,3	68	160,8	48,7	228	218,2	66,1	88	275,6	83,5
49	46,9	14,2	09	104,3	31,6	69	161,7	49,0	229	219,2	66,4	89	276,6	83,8
50	47,9	14,5	110	105,3	31,9	70	162,7	49,3	30	220,1	66,7	90	277,5	84,1
51	48,8	14,8	111	106,2	32,2	171	163,6	49,6	231	221,1	67,0	291	277,5	84,4
52	49,8	15,1	12	107,2	32,5	72	164,6	49,9	32	222,0	67,3	92	279,4	84,7
53	50,7	15,4	13	108,1	32,8	73	165,6	50,2	33	223,0	67,6	93	280,4	85,0
54	51,7	15,7	14	109,1	33,1	74	166,5	50,5	34	223,9	67,9	94	281,4	85,3
55	52,6	16,0	15	110,1	33,4	75	167,5	50,8	35	224,9	68,2	95	282,3	85,6
56	53,6	16,2	16	111,0	33,6	76	168,4	51,0	36	225,9	68,4	96	283,3	85,8
57	54,5	16,5	17	112,0	33,9	77	169,4	51,3	37	226,8	68,7	97	284,2	86,1
58	55,5	16,8	18	112,9	34,2	78	170,3	51,6	38	227,8	69,0	98	285,2	86,4
59	56,5	17,1	19	113,9	34,5	79	171,3	51,9	39	228,7	69,3	99	286,1	86,7
60	57,4	17,4	20	114,8	34,8	80	172,3	52,2	40	229,7	69,6	300	287,1	87,0
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 6 $\frac{1}{2}$ Points.

Difference of Latitude and Departure for $1\frac{1}{2}$ Point.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00,9	00,3	61	57,4	20,5	121	113,9	40,8	181	170,4	61,0	241	226,9	81,2
2	01,9	00,7	62	58,4	20,9	22	114,9	41,1	82	171,4	61,3	42	227,8	81,5
3	02,8	01,0	63	59,3	21,2	23	115,8	41,4	83	172,3	61,6	43	228,8	81,8
4	03,8	01,3	64	60,3	21,6	24	116,7	41,8	84	173,2	62,0	44	229,7	82,2
5	04,7	01,7	65	61,2	21,9	25	117,7	42,1	85	174,2	62,3	45	230,7	82,5
6	05,6	02,0	66	62,1	22,2	26	118,6	42,4	86	175,1	62,6	46	231,6	82,9
7	06,6	02,4	67	63,1	22,6	27	119,6	42,8	87	176,1	63,0	37	232,5	83,2
8	07,5	02,7	68	64,0	22,9	28	120,5	43,1	88	177,0	63,3	48	233,5	83,5
9	08,5	03,0	69	65,0	23,2	29	121,5	43,4	89	177,9	63,7	49	234,4	83,9
10	09,4	03,4	70	65,9	23,6	30	122,4	43,8	90	178,9	64,0	50	235,4	84,2
11	10,4	03,7	71	66,8	23,9	31	123,3	44,1	191	179,8	64,3	251	236,3	84,5
12	11,3	04,0	72	67,8	24,2	32	124,3	44,5	92	180,8	64,7	52	237,2	84,9
13	12,2	04,4	73	68,7	24,6	33	125,2	44,8	93	181,7	65,0	53	238,2	85,2
14	13,2	04,7	74	69,7	24,9	34	126,2	45,1	94	182,6	65,3	54	239,1	85,5
15	14,1	05,1	75	70,6	25,3	35	127,1	45,5	95	183,6	65,7	55	240,1	85,9
16	15,1	05,4	76	71,6	25,6	36	128,0	45,8	96	184,5	66,0	56	241,0	86,2
17	16,0	05,7	77	72,5	25,9	37	129,0	46,1	97	185,5	66,3	57	242,0	86,6
18	17,0	06,1	78	73,4	26,3	38	129,9	46,5	98	186,4	66,7	58	242,9	86,9
19	17,9	06,4	79	74,4	26,6	39	130,9	46,8	99	187,4	67,0	59	243,8	87,2
20	18,8	06,7	80	75,3	26,9	40	131,8	47,2	200	188,3	67,4	60	244,8	87,6
21	19,8	07,1	81	76,3	27,3	141	132,8	47,5	201	189,2	67,7	261	245,7	87,9
22	20,7	07,4	82	77,2	27,6	42	133,7	47,8	02	190,2	68,0	62	246,7	88,2
23	21,7	07,7	83	78,1	28,0	43	134,6	48,2	03	191,1	68,4	63	247,6	88,6
24	22,6	08,1	84	79,1	28,3	44	135,6	48,5	04	192,1	68,7	64	248,6	88,9
25	23,5	08,4	85	80,0	28,6	45	136,5	48,8	05	193,0	69,0	65	249,5	89,2
26	24,5	08,8	86	81,0	29,0	46	137,5	49,2	06	194,0	69,4	66	250,4	89,6
27	25,4	09,1	87	81,9	29,3	47	138,4	49,5	07	194,9	69,7	67	251,4	89,9
28	26,4	09,4	88	82,9	29,6	48	139,3	49,8	08	195,8	70,1	68	252,3	90,3
29	27,3	09,8	89	83,8	30,0	49	140,3	50,2	09	196,8	70,4	69	253,3	90,6
30	28,2	10,1	90	84,7	30,3	50	141,2	50,5	10	197,7	70,7	70	254,2	90,9
31	29,2	10,4	91	85,7	30,6	151	142,2	50,9	211	198,7	71,1	271	255,1	91,3
32	30,1	10,8	92	86,6	31,0	52	143,1	51,2	12	199,6	71,4	72	256,1	91,6
33	31,1	11,1	93	87,6	31,3	53	144,0	51,5	13	200,5	71,7	73	257,0	91,9
34	32,0	11,5	94	88,5	31,7	54	145,0	51,9	14	201,5	72,1	74	258,0	92,3
35	33,0	11,8	95	89,4	32,0	55	145,9	52,2	15	202,4	72,4	75	258,9	92,6
36	33,9	12,1	96	90,4	32,3	56	146,9	52,5	16	203,4	72,7	76	259,9	93,0
37	34,8	12,5	97	91,3	32,7	57	147,8	52,9	17	204,3	73,1	77	260,8	93,3
38	35,8	12,8	98	92,3	33,0	58	148,8	53,2	18	205,2	73,4	78	261,7	93,6
39	36,7	13,1	99	93,2	33,3	59	149,7	53,6	19	206,2	73,8	79	262,7	94,0
40	37,7	13,5	100	94,2	33,7	60	150,6	53,9	20	207,1	74,1	80	263,6	94,3
41	38,6	13,8	101	95,1	34,0	161	151,5	54,2	221	208,1	74,4	281	264,6	94,6
42	39,5	14,1	02	96,0	34,4	62	152,5	54,6	22	209,0	74,8	82	265,5	95,0
43	40,5	14,5	03	97,0	34,7	63	153,5	54,9	23	210,0	75,1	83	266,4	95,3
44	41,4	14,8	04	97,9	35,0	64	154,4	55,2	24	210,9	75,4	84	267,4	95,6
45	42,4	15,2	05	98,9	35,4	65	155,3	55,6	25	211,8	75,8	85	268,3	96,0
46	43,3	15,5	06	99,8	35,7	66	156,3	55,9	26	212,8	76,1	86	269,2	96,3
47	44,3	15,8	07	100,8	36,0	67	157,2	56,2	27	213,7	76,5	87	270,2	96,7
48	45,2	16,2	08	101,7	36,4	68	158,2	56,6	28	214,7	76,8	88	271,2	96,0
49	46,1	16,5	09	102,6	36,7	69	159,1	56,9	29	215,6	77,1	89	272,1	97,3
50	47,1	16,8	10	103,6	37,0	70	160,1	57,3	30	216,5	77,5	90	273,0	97,7
51	48,0	17,2	111	104,5	37,4	171	161,0	57,6	231	217,5	77,8	291	274,0	98,0
52	49,0	17,5	12	105,4	37,7	72	161,9	57,9	32	218,4	78,1	92	274,9	98,3
53	49,9	17,9	13	106,4	38,1	73	162,9	58,3	33	219,4	78,5	93	275,9	98,7
54	50,8	18,2	14	107,3	38,4	74	164,2	58,6	34	220,3	78,8	94	276,8	99,0
55	51,8	18,5	15	108,3	38,7	75	164,8	58,9	35	221,3	79,1	95	277,7	99,4
56	52,7	18,9	16	109,2	39,1	76	165,7	59,3	36	222,2	79,5	96	278,7	99,7
57	53,7	19,2	17	110,2	39,4	77	166,6	59,6	37	223,1	79,8	97	279,6	100,0
58	54,6	19,5	18	111,1	39,7	78	167,6	60,0	38	224,1	80,2	98	280,6	100,4
59	55,5	19,9	19	112,0	40,1	79	168,5	60,3	39	225,0	80,5	99	281,5	100,7
60	56,5	20,2	20	113,0	40,4	80	169,5	60,6	40	226,0	80,8	300	282,5	101,0
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for $6\frac{1}{2}$ Points.

Difference of Latitude and Departure for 2 Points

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00,9	00,4	61	56,4	23,3	121	111,8	46,3	181	167,2	69,3	241	222,7	92,2
2	01,8	00,8	62	57,3	23,7	22	112,7	46,7	82	168,2	69,7	42	223,6	92,6
3	02,8	01,1	63	58,2	24,1	23	113,6	47,1	83	169,1	70,0	43	224,5	93,0
4	03,7	01,5	64	59,1	24,5	24	114,6	47,5	84	170,0	70,4	44	225,4	93,4
5	04,6	01,9	65	60,1	24,9	25	115,5	47,8	85	170,9	70,8	45	226,4	93,8
6	05,5	02,3	66	61,0	25,3	26	116,4	48,2	86	171,9	71,2	46	227,3	94,1
7	06,5	02,7	67	61,9	25,6	27	117,3	48,6	87	172,8	71,6	47	228,2	94,5
8	07,4	03,1	68	62,8	26,0	28	118,3	49,0	88	173,7	72,0	48	229,1	94,9
9	08,3	03,4	69	63,8	26,4	29	119,2	49,4	89	174,6	72,3	49	230,1	95,3
10	09,2	03,8	70	64,7	26,8	30	120,1	49,8	90	175,6	72,7	50	231,0	95,7
11	10,2	04,2	71	65,6	27,2	131	121,0	50,1	191	176,5	73,1	251	231,9	96,1
12	11,1	04,6	72	66,5	27,6	32	122,0	50,5	92	177,4	73,5	52	232,8	96,4
13	12,0	05,0	73	67,5	27,9	33	122,9	50,9	93	178,3	73,9	53	233,8	96,8
14	12,9	05,4	74	68,4	28,3	34	123,8	51,3	94	179,2	74,2	54	234,7	97,2
15	13,9	05,7	75	69,3	28,7	35	124,7	51,7	95	180,2	74,6	55	235,6	97,6
16	14,8	06,1	76	70,2	29,1	36	125,7	52,0	96	181,1	75,0	56	236,5	98,0
17	15,7	06,5	77	71,1	29,5	37	126,6	52,4	97	182,0	75,4	57	237,5	98,4
18	16,6	06,9	78	72,1	29,9	38	127,5	52,8	98	182,9	75,8	58	238,4	98,7
19	17,6	07,3	79	73,0	30,2	39	128,4	53,2	99	183,9	76,2	59	239,3	99,1
20	18,5	07,7	80	73,9	30,6	40	129,4	53,6	200	184,8	76,5	60	240,2	99,5
21	19,4	08,0	81	74,8	31,0	141	130,3	54,0	201	185,7	76,9	261	241,1	99,9
22	20,5	08,4	82	75,8	31,4	42	131,2	54,3	02	186,6	77,3	62	242,1	100,3
23	21,3	08,8	83	76,7	31,8	43	132,1	54,7	03	187,6	77,7	63	243,0	100,7
24	22,2	09,2	84	77,6	32,1	44	133,0	55,1	04	188,5	78,1	64	243,9	101,0
25	23,1	09,6	85	78,5	32,5	45	134,0	55,5	05	189,4	78,5	65	244,8	101,4
26	24,0	10,0	86	79,5	32,9	46	134,9	55,9	06	190,3	78,8	66	245,8	101,8
27	24,9	10,3	87	80,4	33,3	47	135,8	56,3	07	191,3	79,2	67	246,7	102,2
28	25,9	10,7	88	81,3	33,7	48	136,7	56,6	08	192,2	79,6	68	247,6	102,6
29	26,8	11,1	89	82,2	34,1	49	137,7	57,0	09	193,1	80,0	69	248,5	103,0
30	27,7	11,5	90	83,2	34,4	50	138,6	57,4	10	194,0	80,4	70	249,5	103,3
31	28,6	11,9	91	84,1	34,8	151	139,5	57,8	211	194,9	80,8	271	250,4	103,7
32	29,6	12,2	92	85,0	35,2	52	140,4	58,2	12	195,9	81,1	72	251,3	104,1
33	30,5	12,6	93	85,9	35,6	53	141,4	58,6	13	196,8	81,5	73	252,2	104,5
34	31,4	13,0	94	86,9	36,0	54	142,3	58,9	14	197,7	81,9	74	253,2	104,9
35	32,3	13,4	95	87,8	36,4	55	143,2	59,3	15	198,6	82,3	75	254,1	105,2
36	33,3	13,8	96	88,7	36,7	56	144,1	59,7	16	199,6	82,7	76	255,0	105,6
37	34,2	14,2	97	89,6	37,1	57	145,1	60,1	17	200,5	83,0	77	255,9	106,0
38	35,1	14,5	98	90,6	37,5	58	146,0	60,5	18	201,4	83,4	78	256,9	106,4
39	36,0	14,9	99	91,5	37,9	59	146,9	60,9	19	202,3	83,8	79	257,8	106,8
40	37,0	15,3	100	92,4	38,3	60	147,8	61,2	20	203,3	84,2	80	258,7	107,2
41	37,9	15,7	101	93,3	38,7	161	148,8	61,6	221	204,2	84,6	281	259,6	107,5
42	38,8	16,1	02	94,2	39,0	62	149,7	62,0	22	205,1	85,0	82	260,6	107,9
43	39,7	16,5	03	95,1	39,4	63	150,6	62,4	23	206,0	85,3	83	261,5	108,3
44	40,6	16,8	04	96,1	39,8	64	151,5	62,8	24	206,9	85,7	84	262,4	108,7
45	41,6	17,2	05	97,0	40,2	65	152,5	63,1	25	207,9	86,1	85	263,3	109,1
46	42,5	17,6	06	97,9	40,6	66	153,4	63,5	26	208,8	86,5	86	264,2	109,5
47	43,4	18,0	07	98,9	41,0	67	154,3	63,9	27	209,7	86,9	87	265,2	109,8
48	44,4	18,4	08	99,8	41,3	68	155,2	64,3	28	210,7	87,3	88	266,1	110,2
49	45,3	18,8	09	100,7	41,7	69	156,1	64,7	29	210,6	87,6	89	267,0	110,6
50	46,2	19,1	10	101,6	42,1	70	157,1	65,1	30	211,5	88,0	90	267,9	111,0
51	47,1	19,5	111	102,6	42,5	171	158,0	65,4	231	213,4	88,4	291	268,9	111,4
52	48,0	19,9	12	103,5	42,9	72	158,9	65,8	32	214,4	88,8	92	269,8	111,8
53	49,0	20,3	13	104,4	43,2	73	159,8	66,2	33	215,3	89,2	93	270,7	112,1
54	49,9	20,7	14	105,3	43,6	74	160,8	66,6	34	216,2	89,6	94	271,6	112,5
55	50,8	21,0	15	106,3	44,0	75	161,7	67,0	35	217,1	89,9	95	272,6	112,9
56	51,7	21,4	16	107,2	44,4	76	162,1	67,4	36	218,0	90,3	96	273,5	113,3
57	52,7	21,8	17	108,1	44,8	77	163,5	67,7	37	219,0	90,7	97	274,4	113,7
58	53,6	22,2	18	109,0	45,2	78	164,5	68,1	38	219,9	91,1	98	275,3	114,0
59	54,5	22,6	19	109,9	45,5	79	165,4	68,5	39	220,8	91,5	99	276,3	114,4
60	55,4	23,0	20	110,9	45,9	80	166,3	68,9	40	221,7	91,9	100	277,2	114,8
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 6 Points.

Difference of Latitude and Departure for 2 $\frac{1}{4}$ Points.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00,9	00,4	61	55,1	6,1	121	109,4	51,7	181	163,6	77,4	241	217,8	103,0			
2	01,8	00,9	62	56,0	26,5	22	110,3	52,2	82	164,5	77,8	42	218,7	103,5			
3	02,7	01,3	63	57,0	26,9	23	111,2	52,6	83	165,4	78,2	43	219,6	103,9			
4	03,6	01,7	64	57,9	27,4	24	112,1	53,0	84	166,3	78,7	44	220,5	104,3			
5	04,5	02,1	65	58,8	27,8	25	113,0	53,5	85	167,2	79,1	45	221,4	104,8			
6	05,4	02,6	66	59,7	28,2	26	113,9	53,9	86	168,1	79,5	46	222,4	105,2			
7	06,3	03,0	67	60,6	28,6	27	114,8	54,3	87	169,0	80,0	47	222,3	105,6			
8	07,2	03,4	68	61,5	29,1	28	115,7	54,7	88	169,9	80,4	48	222,2	106,0			
9	08,1	03,8	69	62,4	29,5	29	116,6	55,2	89	170,8	80,8	49	222,1	106,5			
10	09,0	04,3	70	63,3	29,9	30	117,5	55,6	90	171,7	81,2	50	222,0	106,9			
11	09,9	4,7	71	64,2	30,4	131	118,4	56,0	191	172,6	81,7	251	226,9	107,3			
12	10,8	05,1	72	65,1	30,8	32	119,3	56,4	92	173,6	82,1	52	227,8	107,8			
13	11,8	05,6	73	66,0	31,2	33	120,2	56,9	93	174,5	82,5	53	228,7	108,2			
14	12,7	06,0	74	66,9	31,6	34	121,1	57,3	94	175,4	83,0	54	229,6	108,6			
15	13,6	06,4	75	67,8	32,1	35	122,0	57,7	95	176,3	83,4	55	230,5	109,0			
16	14,5	06,8	76	68,7	32,5	36	122,9	58,2	96	177,3	83,8	56	231,4	109,5			
17	15,4	07,3	77	69,6	32,9	37	123,8	58,6	97	178,2	84,2	57	232,3	109,9			
18	16,3	07,7	78	70,5	33,4	38	124,7	59,0	98	179,1	84,7	58	233,2	110,3			
19	17,2	08,1	79	71,4	33,8	39	125,6	59,4	99	179,9	85,1	59	234,1	110,7			
20	18,1	08,6	80	72,3	34,2	40	126,5	59,9	200	180,8	85,5	60	235,0	111,2			
21	19,0	09,0	81	73,2	34,6	141	127,4	60,3	201	181,7	85,9	261	235,9	111,6			
22	19,9	09,4	82	74,1	35,1	42	128,3	60,7	02	182,6	86,4	62	236,8	112,0			
23	20,8	09,8	83	75,0	35,5	43	129,3	61,1	03	183,5	86,8	63	237,7	112,5			
24	21,7	10,3	84	75,9	35,9	44	130,2	61,6	04	184,4	87,2	64	238,6	112,9			
25	22,6	10,7	85	76,8	36,3	45	131,1	62,0	05	185,3	87,7	65	239,5	113,3			
26	23,5	11,1	86	77,7	36,8	46	132,0	62,4	06	186,2	88,1	66	240,4	113,7			
27	24,4	11,5	87	78,6	37,2	47	132,9	62,9	07	187,1	88,5	67	241,3	114,2			
28	25,3	12,0	88	79,6	37,6	48	133,8	63,3	08	188,0	88,9	68	242,2	114,6			
29	26,2	12,4	89	80,5	38,1	49	134,7	63,7	09	188,9	89,4	69	243,1	115,0			
30	27,1	12,8	90	81,4	38,5	50	135,6	64,1	10	189,8	89,8	70	244,0	115,5			
31	28,0	13,3	91	82,3	38,9	151	136,5	64,6	211	190,7	90,2	271	245,0	115,9			
32	28,9	13,7	92	83,2	39,3	52	137,4	65,0	12	191,6	90,6	72	245,9	116,3			
33	29,8	14,1	93	84,1	39,8	53	138,3	65,4	13	192,5	91,1	73	246,8	116,7			
34	30,7	14,5	94	85,0	40,2	54	139,2	65,8	14	193,4	91,5	74	247,7	117,2			
35	31,6	15,0	95	85,9	40,6	55	140,1	66,3	15	194,3	91,9	75	248,6	117,6			
36	32,5	15,4	96	86,8	41,0	56	141,0	66,7	16	195,2	92,4	76	249,5	118,0			
37	33,4	15,8	97	87,7	41,5	57	141,9	67,1	17	196,1	92,8	77	250,4	118,4			
38	34,3	16,2	98	88,6	41,9	58	142,8	67,6	18	197,0	93,2	78	251,3	118,9			
39	35,3	16,7	99	89,5	42,3	59	143,7	68,0	19	197,9	93,6	79	252,2	119,3			
40	36,2	17,1	100	90,4	42,8	60	144,6	68,4	20	198,8	94,1	80	253,1	119,7			
41	37,1	17,5	101	91,3	43,2	161	145,5	68,8	221	199,8	94,5	281	254,0	120,2			
42	38,0	18,0	02	92,2	43,6	62	146,4	69,3	22	200,7	94,9	82	254,9	120,6			
43	38,9	18,4	03	93,1	44,0	63	147,3	69,7	23	201,6	95,4	83	255,8	121,0			
44	39,8	18,8	04	94,0	44,5	64	148,2	70,1	24	202,5	95,8	84	256,7	121,4			
45	40,7	19,2	05	94,9	44,9	65	149,1	70,6	25	203,4	96,2	85	257,6	121,9			
46	41,6	19,7	06	95,8	45,3	66	150,0	71,0	26	204,3	96,6	86	258,5	122,3			
47	42,5	20,1	07	96,7	45,8	67	151,0	71,4	27	205,2	97,1	87	259,4	122,7			
48	43,4	20,5	08	97,6	46,2	68	151,9	71,8	28	206,1	97,5	88	260,3	123,1			
49	44,3	21,0	09	98,5	46,6	69	152,8	72,3	29	207,0	97,9	89	261,2	123,6			
50	45,2	21,4	10	99,4	47,0	70	153,7	72,7	30	207,9	98,3	90	262,1	124,0			
51	46,1	21,8	111	100,3	47,5	171	154,6	73,1	231	208,8	98,8	291	263,0	124,4			
52	47,0	22,2	12	101,2	47,9	72	155,5	73,5	32	209,7	99,1	292	263,9	124,9			
53	47,9	22,7	13	102,1	48,3	73	156,4	74,0	33	210,6	99,6	293	264,8	125,3			
54	48,8	23,1	14	103,0	48,7	74	157,3	74,4	34	211,5	100,1	294	265,7	125,7			
55	49,7	23,5	15	103,9	49,2	75	158,2	74,8	35	212,4	100,5	295	266,6	126,1			
56	50,6	23,9	16	104,8	49,6	76	159,1	75,3	36	213,3	100,9	296	267,5	126,6			
57	51,5	24,4	17	105,8	50,0	77	160,0	75,7	37	214,2	101,3	297	268,4	127,0			
58	52,4	24,8	18	106,7	50,5	78	160,9	76,1	38	215,1	101,8	298	269,3	127,4			
59	53,3	25,2	19	107,6	50,9	79	161,8	76,5	39	216,0	102,2	299	270,2	127,8			
60	54,2	25,7	20	108,5	51,3	80	162,7	77,0	40	216,9	102,6	300	271,1	128,3			
Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.

[b]

for 5 $\frac{1}{2}$ Points.

Difference of Latitude and Departure for 2 1/2 Points.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00,9	00,5	61	53,8	28,7	121	106,7	57,0	181	159,6	85,3	241	212,6	113,5
2	01,8	00,9	62	54,7	29,2	22	107,6	57,5	82	160,5	85,8	42	213,4	114,0
3	02,6	01,4	63	55,6	29,7	23	108,5	58,0	83	161,4	86,2	43	214,3	114,5
4	03,5	01,9	64	56,4	30,2	24	109,4	58,4	84	162,3	86,7	44	215,2	115,0
5	04,4	02,4	65	57,3	30,6	25	110,3	58,9	85	163,2	87,2	45	216,1	115,4
6	05,3	02,8	66	58,2	31,1	26	111,0	59,4	86	164,1	87,6	46	217,0	115,9
7	06,2	03,3	67	59,1	31,6	27	112,1	59,8	87	164,6	88,1	47	217,9	116,4
8	07,1	03,8	68	60,0	32,0	28	112,9	60,3	88	165,8	88,6	48	218,7	116,8
9	07,9	04,2	69	60,9	32,5	29	113,8	60,8	89	166,7	89,1	49	219,6	117,3
10	08,8	04,7	70	61,7	33,0	30	114,7	61,3	90	167,6	89,5	50	220,5	117,8
11	09,7	05,2	71	62,6	33,5	131	115,5	61,7	191	168,5	90,0	251	221,4	118,3
12	10,6	05,7	72	63,5	33,9	32	116,4	62,2	92	169,3	90,5	52	222,3	118,7
13	11,5	06,1	73	64,4	34,4	33	117,3	62,7	93	170,2	90,9	53	223,1	119,2
14	12,3	06,6	74	65,3	34,9	34	118,2	63,1	94	171,1	91,4	54	224,0	119,7
15	13,2	07,1	75	66,2	35,3	35	119,1	63,6	95	172,0	91,9	55	224,9	120,1
16	14,2	07,5	76	67,0	35,8	36	120,0	64,1	96	172,9	92,4	56	225,8	120,6
17	15,0	08,0	77	67,9	36,3	37	120,8	64,5	97	173,8	92,8	57	226,7	121,1
18	15,9	08,5	78	68,8	36,8	38	121,7	65,0	98	174,6	93,3	58	227,6	121,6
19	16,8	09,0	79	69,7	37,2	39	122,6	65,5	99	175,5	93,8	59	228,4	122,0
20	17,6	09,4	80	70,6	37,7	40	123,5	66,0	200	176,4	94,2	60	229,3	122,5
21	18,5	09,9	81	71,4	38,2	141	124,4	66,4	201	177,3	94,7	261	230,2	123,0
22	19,4	10,4	82	72,3	38,6	42	125,2	66,9	02	178,2	95,2	62	231,1	123,4
23	20,3	10,8	83	73,2	39,1	43	126,1	67,4	03	179,0	95,6	63	232,0	123,9
24	21,2	11,3	84	74,1	39,6	44	127,0	67,8	04	179,9	96,1	64	232,8	124,4
25	22,1	11,8	85	75,0	40,1	45	127,9	68,3	05	180,8	96,6	65	233,7	124,9
26	22,9	12,3	86	75,9	40,5	46	128,8	68,8	06	181,7	97,1	66	234,6	125,3
27	23,8	12,7	87	76,7	41,0	47	129,6	69,3	07	182,6	97,5	67	235,5	125,8
28	24,7	13,2	88	77,6	41,5	48	130,5	69,7	08	183,5	98,0	68	236,4	126,3
29	25,6	13,7	89	78,5	41,9	49	131,4	70,2	09	184,3	98,5	69	237,3	126,7
30	26,5	14,1	90	79,4	42,4	50	132,3	70,7	10	185,2	98,9	70	238,1	127,2
31	27,3	14,6	91	80,3	42,9	151	133,2	71,1	211	186,1	99,4	271	239,0	127,7
32	28,2	15,1	92	81,1	43,4	52	134,1	71,6	12	187,0	99,9	72	239,9	128,2
33	29,1	15,5	93	82,0	43,8	53	134,9	72,1	13	187,9	100,4	73	240,8	128,6
34	30,0	16,0	94	82,9	44,3	54	135,8	72,6	14	188,7	100,8	74	241,7	129,1
35	30,9	16,5	95	83,8	44,8	55	136,7	73,0	15	189,6	101,3	75	242,5	129,6
36	31,8	17,0	96	84,7	45,2	56	137,6	73,5	16	190,5	101,8	76	243,4	130,0
37	32,6	17,4	97	85,6	45,7	57	138,5	74,0	17	191,4	102,2	77	244,3	130,5
38	33,5	17,9	98	86,4	46,2	58	139,4	74,4	18	192,3	102,7	78	245,2	131,0
39	34,4	18,4	99	87,3	46,6	59	140,2	74,9	19	193,2	103,2	79	246,1	131,5
40	35,3	18,8	100	88,2	47,1	60	141,1	75,4	20	194,0	103,7	80	247,0	131,9
41	36,2	19,3	101	89,1	47,6	161	142,0	75,9	221	194,9	104,1	281	247,8	132,4
42	37,0	19,8	02	90,0	48,1	62	142,9	76,3	22	195,8	104,6	82	248,7	132,9
43	37,9	20,3	03	90,8	48,5	63	143,8	76,8	23	196,7	105,1	83	249,6	133,3
44	38,8	20,7	04	91,7	49,0	64	144,6	77,3	24	197,6	105,5	84	250,5	133,8
45	39,7	21,2	05	92,6	49,5	65	145,5	77,7	25	198,4	106,0	85	251,4	134,3
46	40,6	21,7	06	93,5	49,9	66	146,4	78,2	26	199,3	106,5	86	252,3	134,8
47	41,5	22,1	07	94,4	50,4	67	147,3	78,7	27	200,2	107,0	87	253,1	135,2
48	42,3	22,6	08	95,3	50,9	68	148,2	79,2	28	201,1	107,4	88	254,0	135,7
49	43,2	23,1	09	96,1	51,4	69	149,1	79,6	29	202,0	107,9	89	254,9	136,2
50	44,1	23,6	10	97,0	51,8	70	149,9	80,1	30	202,9	108,4	90	255,8	136,6
51	45,0	24,0	111	97,9	52,3	171	150,8	80,6	231	203,7	108,8	291	256,7	137,1
52	45,9	24,5	12	98,8	52,8	72	151,7	81,0	32	204,6	109,3	92	257,5	137,6
53	46,7	25,0	13	99,7	53,2	73	152,6	81,5	33	205,5	109,8	93	258,4	138,1
54	47,6	25,4	14	100,5	53,7	74	153,5	82,0	34	206,4	110,3	94	259,3	138,5
55	48,5	25,9	15	101,4	54,2	75	154,4	82,5	35	207,3	110,7	95	260,2	139,0
56	49,4	26,4	16	102,3	54,7	76	155,2	82,9	36	208,2	111,2	96	261,1	139,5
57	50,3	26,9	17	103,2	55,1	77	156,1	83,4	37	209,0	111,7	97	262,0	139,9
58	51,2	27,3	18	104,1	55,6	78	157,0	83,9	38	209,9	112,1	98	262,8	140,4
59	52,0	27,8	19	105,0	56,1	79	157,9	84,3	39	210,8	112,6	99	263,7	140,9
60	52,9	28,3	20	105,8	56,5	80	158,8	84,8	40	211,7	113,1	300	264,6	141,4
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 5 1/2 Points.

Difference of Latitude and Departure for 2 $\frac{1}{2}$ Point.

Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.
1	00,9	00,6	61	52,3	31,4	121	103,8	62,2	181	185,2	93,0	241	206,7	123,9
2	01,7	01,0	62	53,2	31,9	22	104,6	62,7	82	156,1	93,5	42	207,6	124,4
3	02,6	01,5	63	54,0	32,4	23	105,5	63,2	83	157,0	94,0	43	208,4	124,9
4	03,4	02,1	64	54,9	32,9	24	106,4	63,7	84	157,8	94,6	44	209,3	125,4
5	04,3	02,6	65	55,8	33,4	25	107,2	64,2	85	158,7	95,1	45	210,1	125,9
6	05,1	03,1	66	56,6	33,9	26	108,1	64,8	86	159,5	95,6	46	211,0	126,4
7	06,0	03,6	67	57,5	34,4	27	108,9	65,3	87	160,4	96,1	47	211,9	126,9
8	06,9	04,1	68	58,3	35,0	28	109,8	65,8	88	161,2	96,6	48	212,7	127,4
9	07,7	04,6	69	59,2	35,5	29	110,6	66,3	89	162,1	97,1	49	213,6	127,9
10	08,6	05,1	70	60,0	36,0	30	111,5	66,8	90	163,0	97,6	50	214,4	128,5
11	09,4	05,7	71	60,9	36,5	31	112,4	67,3	91	163,8	98,2	51	215,3	129,0
12	10,3	06,2	72	61,8	37,0	32	113,2	67,8	92	164,7	98,7	52	216,1	129,5
13	11,2	06,7	73	62,6	37,6	33	114,1	68,4	93	165,5	99,2	53	217,0	130,0
14	12,0	07,2	74	63,5	38,0	34	114,9	68,9	94	166,4	99,7	54	217,9	130,5
15	12,5	07,7	75	64,3	38,6	35	115,8	69,4	95	167,3	100,2	55	218,7	131,0
16	13,7	08,2	76	65,2	39,1	36	116,6	69,9	96	168,1	100,7	56	219,6	131,1
17	14,6	08,7	77	66,0	39,6	37	117,5	70,4	97	169,0	101,2	57	220,4	132,1
18	15,4	09,3	78	66,9	40,1	38	118,4	70,9	98	169,8	101,8	58	221,3	132,6
19	16,3	09,8	79	67,8	40,6	39	119,2	71,4	99	170,7	102,3	59	222,1	133,1
20	17,2	10,3	80	68,6	41,1	40	120,1	72,0	200	171,5	102,8	60	223,0	133,6
21	18,0	10,8	81	69,5	41,6	41	120,9	72,5	201	172,4	103,3	61	223,9	134,1
22	18,9	11,3	82	70,3	42,2	42	121,8	73,0	02	173,3	103,8	62	224,7	134,6
23	19,7	11,8	83	71,2	42,7	43	122,7	73,5	03	174,1	104,3	63	225,6	135,2
24	20,6	12,3	84	72,0	43,2	44	123,5	74,0	04	175,0	104,8	64	226,4	135,7
25	21,4	12,9	85	72,9	43,7	45	124,4	74,6	05	175,8	105,4	65	227,3	136,2
26	22,3	13,4	86	73,8	44,2	46	125,2	75,0	06	176,7	105,9	66	228,1	136,7
27	23,2	13,9	87	74,6	44,7	47	126,1	75,6	07	177,5	106,4	67	229,0	137,2
28	24,0	14,4	88	75,5	45,2	48	126,9	76,1	08	178,4	106,9	68	229,9	137,7
29	24,9	14,9	89	76,3	45,7	49	127,8	76,6	09	179,3	107,4	69	230,7	138,2
30	25,7	15,4	90	77,2	46,3	50	128,7	77,1	10	180,1	107,9	70	231,6	138,8
31	26,6	15,9	91	78,1	46,8	151	129,5	77,6	211	181,0	108,4	71	232,4	139,3
32	27,4	16,4	92	78,9	47,3	52	130,4	78,1	12	181,8	109,0	72	233,3	139,8
33	28,3	17,0	93	79,8	47,8	53	131,2	78,6	13	182,7	109,5	73	234,2	140,3
34	29,2	17,5	94	80,6	48,3	54	132,1	79,1	14	183,5	110,0	74	235,0	140,8
35	30,0	18,0	95	81,5	48,8	55	132,9	79,7	15	184,4	110,5	75	235,9	141,3
36	30,9	18,5	96	82,3	49,3	56	133,8	80,2	16	185,3	111,0	76	236,7	141,8
37	31,7	19,0	97	83,2	49,9	57	134,7	80,7	17	186,1	111,6	77	237,6	142,4
38	32,6	19,5	98	84,1	50,4	58	135,5	81,2	18	187,0	112,0	78	238,4	142,9
39	33,5	20,0	99	84,6	50,9	59	136,4	81,7	19	187,8	112,6	79	239,3	143,4
40	34,3	20,6	100	85,8	51,4	60	137,2	82,2	20	188,7	113,1	80	240,2	143,9
41	35,2	21,1	01	86,6	51,9	161	138,1	82,7	221	189,6	113,6	281	241,0	144,4
42	36,0	21,6	02	87,5	52,4	62	138,9	83,3	22	190,4	114,1	82	241,9	144,9
43	36,9	22,9	03	88,3	52,9	63	139,8	83,8	23	191,3	114,6	83	242,7	145,4
44	37,7	22,6	04	89,2	53,4	64	140,7	84,3	24	192,1	115,1	84	243,6	146,0
45	38,6	23,1	05	90,1	54,0	65	141,5	84,8	25	193,0	115,6	85	244,4	146,5
46	39,5	23,6	06	90,9	54,5	66	142,4	85,3	26	193,8	116,1	86	245,3	147,0
47	40,3	24,2	07	91,8	55,0	67	143,2	85,8	27	194,7	116,7	87	246,2	147,5
48	41,2	24,7	08	92,6	55,5	68	144,1	86,3	28	195,6	117,2	88	247,0	148,0
49	42,0	25,2	09	93,5	56,0	69	145,0	86,9	29	196,4	117,7	89	247,9	148,6
50	42,9	25,7	110	94,3	56,5	70	145,8	87,4	30	197,3	118,2	90	248,7	149,0
51	43,7	26,2	111	95,2	57,0	171	146,7	87,9	231	198,1	118,7	291	249,6	149,6
52	44,6	26,7	12	96,1	57,6	72	147,5	88,4	32	199,0	119,2	92	250,4	150,1
53	45,5	27,2	13	96,9	58,1	73	148,4	88,9	33	199,8	119,7	93	251,3	150,6
54	46,3	27,8	14	97,8	58,6	74	149,2	89,4	34	200,7	120,3	94	252,2	151,1
55	47,2	28,3	15	98,6	59,1	75	150,1	89,9	35	201,6	120,8	95	253,0	151,6
56	48,0	28,8	16	99,5	59,6	76	151,0	90,4	36	202,4	121,3	96	253,9	152,1
57	48,9	29,3	17	100,4	60,1	77	151,8	91,0	37	203,3	121,8	97	254,7	152,6
58	49,7	29,8	18	101,2	60,6	78	152,7	91,5	38	204,1	122,3	98	255,6	153,1
59	50,6	30,3	19	102,1	61,2	79	153,5	92,0	39	205,0	122,8	99	256,5	153,8
60	51,5	30,8	20	102,9	61,7	80	154,4	92,5	40	205,8	123,3	300	257,3	154,2
Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.

Difference of Latitude and Departure for 3 Points.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00,8	00,6	61	50,7	33,9	121	100,9	67,2	181	150,5	100,3	241	200,4	133,9
2	01,7	01,1	62	51,5	34,4	22	101,4	67,8	82	151,3	101,1	42	201,2	134,4
3	02,5	01,7	63	52,4	35,0	23	102,3	68,3	83	152,1	101,7	43	202,0	135,0
4	03,3	02,2	64	53,2	35,6	24	103,1	68,9	84	153,0	102,2	44	202,8	135,5
5	04,2	02,8	65	54,0	36,1	25	103,6	69,4	85	153,8	102,8	45	203,7	136,1
6	05,0	03,3	66	54,9	36,7	26	104,8	70,0	86	154,6	103,3	46	204,5	136,7
7	05,8	03,9	67	55,7	37,2	27	105,6	70,5	87	155,5	103,9	47	205,3	137,2
8	06,7	04,4	68	56,5	37,8	28	106,4	71,1	88	156,3	104,4	48	206,2	137,8
9	07,5	05,0	69	57,4	38,3	29	107,2	71,7	89	157,1	105,0	49	207,0	138,3
10	08,3	05,6	70	58,2	38,9	30	108,1	72,2	90	158,0	105,5	50	207,8	138,9
11	09,1	06,1	71	59,0	39,4	31	108,9	72,8	91	158,8	106,1	51	208,7	139,4
12	10,0	06,7	72	59,9	40,0	32	109,7	73,3	92	159,6	106,7	52	209,5	140,0
13	10,8	07,2	73	60,7	40,6	33	110,6	73,9	93	160,4	107,2	53	210,3	140,5
14	11,6	07,8	74	61,5	41,1	34	111,4	74,4	94	161,3	107,8	54	211,2	141,1
15	12,5	08,5	75	62,4	41,7	35	112,2	75,0	95	162,1	108,3	55	212,0	141,7
16	13,3	08,9	76	63,2	42,2	36	113,1	75,5	96	162,9	108,9	56	212,8	142,2
17	14,1	09,4	77	64,0	42,8	37	113,9	76,1	97	163,8	109,4	57	213,7	142,8
18	15,0	10,0	78	64,8	43,3	38	114,7	76,7	98	164,6	110,0	58	214,5	143,3
19	15,8	10,6	79	65,7	43,9	39	115,6	77,2	99	165,4	110,5	59	215,3	143,9
20	16,6	11,1	80	66,5	44,4	40	116,4	77,8	200	166,3	111,1	60	216,1	144,4
21	17,5	11,7	81	67,3	45,0	41	117,2	78,3	201	167,1	111,7	61	217,0	145,0
22	18,3	12,2	82	68,2	45,6	42	118,1	78,9	02	167,9	112,2	62	217,8	145,5
23	19,1	12,8	83	69,0	46,1	43	118,9	79,4	03	168,8	112,8	63	218,6	146,1
24	20,0	13,3	84	69,8	46,7	44	119,7	80,0	04	169,6	113,3	64	219,5	146,7
25	20,8	13,9	85	70,7	47,2	45	120,5	80,5	05	170,4	113,9	65	220,3	147,2
26	21,6	14,4	86	71,5	47,8	46	121,4	81,1	06	171,3	114,4	66	221,1	147,8
27	22,4	15,1	87	72,3	48,3	47	122,2	81,7	07	172,1	115,0	67	222,0	148,3
28	23,3	15,6	88	73,2	48,9	48	123,0	82,2	08	172,9	115,5	68	222,8	148,9
29	24,1	16,1	89	74,0	49,4	49	123,9	82,8	09	173,8	116,1	69	223,6	149,4
30	24,9	16,7	90	74,8	50,0	50	124,7	83,3	10	174,6	116,7	70	224,5	150,0
31	25,8	17,2	91	75,7	50,6	51	125,5	83,9	211	175,4	117,2	271	225,3	150,5
32	26,6	17,8	92	76,5	51,1	52	126,4	84,4	12	176,2	117,8	72	226,1	151,1
33	27,4	18,5	93	77,3	51,7	53	127,2	85,0	13	177,1	118,3	73	227,0	151,7
34	28,3	18,9	94	78,1	52,2	54	128,0	85,5	14	177,9	118,9	74	227,8	152,2
35	29,1	19,4	95	79,0	52,8	55	128,9	86,1	15	178,7	119,4	75	228,6	152,8
36	29,9	20,0	96	79,8	53,3	56	129,7	86,7	16	179,6	120,0	76	229,4	153,3
37	30,8	20,6	97	80,6	53,9	57	130,5	87,2	17	180,4	120,5	77	230,0	153,9
38	31,6	21,1	98	81,5	54,4	58	131,4	87,8	18	181,2	121,1	78	231,1	154,4
39	32,4	21,7	99	82,3	55,0	59	132,2	88,3	19	182,1	121,7	79	231,0	155,0
40	33,3	22,2	100	83,1	55,6	60	133,0	88,9	20	182,9	122,2	80	232,8	155,5
41	34,1	22,8	101	84,0	56,1	161	133,8	89,4	221	183,7	122,8	281	233,6	156,1
42	34,9	23,3	02	84,8	56,7	62	134,7	90,0	22	184,6	123,3	82	234,4	156,7
43	35,8	23,9	03	85,6	57,2	63	135,5	90,5	23	185,4	123,9	83	235,3	157,2
44	36,6	24,4	04	86,5	57,8	64	136,3	91,1	24	186,2	124,4	84	236,1	157,8
45	37,4	25,0	05	87,3	58,3	65	137,2	91,7	25	187,1	125,0	85	236,9	158,3
46	38,3	25,6	06	88,1	58,9	66	138,0	92,2	26	187,9	125,5	86	237,8	158,9
47	39,1	26,1	07	89,0	59,4	67	138,8	92,8	27	188,7	126,1	87	238,6	159,4
48	39,9	26,7	08	89,8	60,0	68	139,7	93,3	28	189,5	126,7	88	239,4	160,0
49	40,7	27,2	09	90,6	60,5	69	140,5	93,9	29	190,4	127,2	89	240,3	160,5
50	41,6	27,8	10	91,4	61,1	70	141,3	94,4	30	191,2	127,8	90	241,1	161,1
51	42,4	28,3	11	92,3	61,7	171	142,2	95,0	231	192,0	128,3	291	242,0	161,7
52	43,2	28,9	12	93,1	62,2	72	143,0	95,5	32	192,9	128,9	92	243,8	162,2
53	44,1	29,4	13	93,9	62,8	73	143,8	96,1	33	193,7	129,4	93	243,6	162,8
54	44,9	30,0	14	94,8	63,3	74	144,7	96,7	34	194,5	130,0	94	244,4	163,3
55	45,7	30,6	15	95,6	63,9	75	145,5	97,2	35	195,4	130,5	95	245,2	163,9
56	46,6	31,1	16	96,4	64,4	76	146,3	97,8	36	196,2	131,1	96	246,1	164,4
57	47,4	31,7	17	97,3	65,0	77	147,1	98,3	37	197,0	131,7	97	246,9	165,0
58	48,2	32,2	18	98,1	65,5	78	148,0	98,9	38	197,9	132,2	98	247,7	165,5
59	49,1	32,8	19	98,9	66,1	79	148,8	99,4	39	198,7	132,8	99	248,5	166,1
60	49,9	33,3	20	99,8	66,7	80	149,6	100,0	40	199,5	133,3	500	249,4	166,7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 5 Points.

Difference of Latitude and Departure for 3 $\frac{1}{4}$ Points.

Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.
1	00,8	00,6	61	49,0	36,3	121	97,2	72,1	181	145,4	107,8	241	193,5	143,6
2	01,6	01,2	62	49,8	36,9	22	98,0	72,7	82	146,2	108,4	42	194,3	144,2
3	02,4	01,8	63	50,6	37,5	23	98,8	73,3	83	147,0	109,0	43	195,1	144,8
4	03,2	02,4	64	51,6	38,1	24	99,6	73,9	84	147,8	109,6	44	195,9	145,4
5	04,0	03,0	65	52,2	38,7	25	100,4	74,5	85	148,6	110,2	45	196,7	146,0
6	04,8	03,6	66	53,0	39,3	26	101,2	75,1	86	149,4	110,8	46	197,5	146,6
7	05,6	04,2	67	53,8	39,9	27	102,0	75,7	87	150,2	111,4	47	198,4	147,1
8	06,4	04,8	68	54,6	40,5	28	102,8	76,3	88	151,0	112,0	48	199,2	147,7
9	07,2	05,4	69	55,4	41,1	29	103,6	76,9	89	151,8	112,6	49	200,0	148,3
10	08,0	06,0	70	56,2	41,7	30	104,4	77,4	90	152,6	113,2	50	200,8	148,9
11	08,8	06,6	71	57,0	42,3	131	105,2	78,0	191	153,4	113,8	251	201,6	149,5
12	09,6	07,1	72	57,8	42,9	32	106,0	78,6	92	154,2	114,4	52	202,4	150,1
13	10,4	07,7	73	58,6	43,5	33	106,8	79,2	93	155,0	115,0	53	203,2	150,7
14	11,2	08,3	74	59,4	44,1	34	107,6	79,8	94	155,8	115,6	54	204,0	151,3
15	12,0	08,9	75	60,2	44,7	35	108,4	80,4	95	156,6	116,2	55	204,8	151,9
16	12,8	09,5	76	61,0	45,3	36	109,2	81,0	96	157,4	116,8	56	205,6	152,5
17	13,7	10,1	77	61,8	46,9	37	110,0	81,6	97	158,2	117,4	57	206,4	153,1
18	14,5	10,7	78	62,6	45,5	38	110,8	82,2	98	159,0	118,0	58	207,2	153,7
19	15,3	11,3	79	63,4	47,1	39	111,6	82,8	99	159,8	118,6	59	208,0	154,3
20	16,1	11,9	80	64,2	47,7	40	112,4	83,4	200	160,6	119,1	60	208,8	154,9
21	16,9	12,5	81	65,0	48,3	141	113,2	84,0	201	161,4	119,7	261	209,6	155,5
22	17,7	13,1	82	65,8	48,9	42	114,0	84,6	02	162,2	120,3	62	210,4	156,1
23	18,5	13,7	83	66,7	49,4	43	114,8	85,2	03	163,0	120,9	63	211,2	156,7
24	19,3	14,3	84	67,5	50,0	44	115,6	85,8	04	163,8	121,5	64	212,0	157,3
25	20,1	14,9	85	68,3	50,6	45	116,4	86,4	05	164,6	122,1	65	212,8	157,9
26	20,9	15,5	86	69,1	51,2	46	117,2	87,0	06	165,4	122,7	66	213,6	158,5
27	21,7	16,1	87	69,9	51,8	47	118,0	87,6	07	166,2	123,3	67	214,4	159,1
28	22,5	16,7	88	70,7	52,4	48	118,8	88,2	08	167,0	123,9	68	215,2	159,7
29	23,3	17,3	89	71,5	53,0	49	119,7	88,8	09	167,8	124,5	69	216,0	160,3
30	24,1	17,9	90	72,3	53,6	50	120,5	89,4	10	168,6	125,1	70	216,8	160,9
31	24,9	18,5	91	73,1	54,2	151	121,3	90,0	211	169,4	125,7	271	217,6	161,4
32	25,7	19,1	92	73,9	54,8	52	122,1	90,6	12	170,2	126,3	72	218,4	162,0
33	26,5	19,7	93	74,7	55,4	53	122,9	91,1	13	171,0	126,9	73	219,2	162,6
34	27,3	20,3	94	75,5	56,0	54	123,7	91,7	14	171,8	127,5	74	220,0	163,2
35	28,1	20,9	95	76,3	56,6	55	124,5	92,3	15	172,7	128,1	75	220,8	163,8
36	28,9	21,4	96	77,1	57,2	56	125,3	92,9	16	173,5	128,7	76	221,6	164,4
37	29,7	22,0	97	77,9	57,8	57	126,1	93,5	17	174,3	129,3	77	222,4	165,0
38	30,5	22,6	98	78,7	58,4	58	126,9	94,1	18	175,1	129,9	78	223,2	165,6
39	31,3	23,2	99	79,5	59,0	59	127,7	94,7	19	175,9	130,5	79	224,0	166,2
40	32,1	23,8	100	80,3	59,6	60	128,5	95,3	20	176,7	131,1	80	224,8	166,8
41	32,9	24,4	101	81,1	60,2	161	129,3	95,9	221	177,5	131,7	281	225,7	167,4
42	33,7	25,0	02	81,9	60,8	62	130,1	96,5	22	178,3	132,3	82	226,5	168,0
43	34,5	25,6	03	82,7	61,4	63	130,9	97,1	23	179,1	132,9	83	227,3	168,6
44	35,3	26,2	04	83,5	62,0	64	131,7	97,7	24	179,9	133,4	84	228,1	169,2
45	36,1	26,8	05	84,3	62,6	65	132,5	98,3	25	180,7	134,0	85	228,9	169,8
46	36,9	27,4	06	85,1	63,1	66	133,3	98,9	26	181,5	134,6	86	229,7	170,4
47	37,7	28,0	07	85,9	63,7	67	134,1	99,5	27	182,3	135,2	87	230,5	171,0
48	38,5	28,6	08	86,7	64,3	68	134,9	100,1	28	183,1	135,8	88	231,3	171,6
49	39,3	29,2	09	87,5	64,9	69	135,7	100,7	29	183,9	136,4	89	232,1	172,2
50	40,2	29,8	10	88,3	65,5	70	136,5	101,3	30	184,7	137,0	290	232,9	172,8
51	41,0	30,4	111	89,1	66,1	171	137,3	101,9	231	185,5	137,6	291	233,7	173,4
52	41,8	31,0	12	89,9	66,7	72	138,1	102,5	32	186,3	138,2	92	234,5	174,0
53	42,6	31,6	13	90,7	67,3	73	138,9	103,1	33	187,1	138,8	93	235,3	174,6
54	43,4	32,2	14	91,5	67,9	74	139,7	103,7	34	187,9	139,4	94	236,1	175,1
55	44,2	32,8	15	92,4	68,5	75	140,5	104,3	35	188,7	140,0	95	236,9	175,7
56	45,0	33,4	16	93,2	69,1	76	141,3	104,9	36	189,5	140,6	96	237,7	176,3
57	45,8	34,0	17	94,0	69,7	77	142,1	105,4	37	190,3	141,2	97	238,5	176,9
58	46,6	34,6	18	94,8	70,3	78	142,9	106,0	38	191,1	141,8	98	239,3	177,5
59	47,4	35,1	19	95,6	70,9	79	143,7	106,6	39	191,9	142,4	99	240,1	178,1
60	48,2	35,7	20	96,4	71,5	80	144,5	107,2	40	192,7	143,0	300	240,9	178,7
Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.

for 4 $\frac{1}{2}$ Points.

Difference of Latitude and Departure for 3 1/2 Points.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00,8	00,6	61	47,1	38,7	121	93,5	76,7	181	139,9	114,8	241	186,2	152,8
2	01,5	01,3	62	47,9	39,3	22	94,3	77,4	82	140,6	115,4	42	187,0	153,5
3	02,3	01,9	63	48,7	40,0	23	95,1	78,0	83	141,4	116,0	43	187,8	154,1
4	03,1	02,5	64	49,5	40,6	24	95,8	78,6	84	142,2	116,7	44	188,6	154,7
5	03,9	03,2	65	50,2	41,2	25	96,6	79,3	85	143,0	117,3	45	189,3	155,4
6	04,6	03,8	66	51,0	41,9	26	97,4	79,9	86	143,7	118,0	46	190,1	156,0
7	05,4	04,4	67	51,8	42,5	27	98,1	80,5	87	144,5	118,6	47	190,9	156,6
8	06,2	05,1	68	52,6	43,1	28	98,9	81,2	88	145,3	119,2	48	191,6	157,3
9	07,0	05,7	69	53,3	43,8	29	99,7	81,8	89	146,1	119,9	49	192,4	157,9
10	07,7	06,3	70	54,1	44,4	30	100,5	82,4	90	146,8	120,5	50	193,2	158,5
11	08,5	07,0	71	54,9	45,0	131	101,2	83,1	191	147,6	121,1	251	194,0	159,2
12	09,3	07,6	72	55,6	45,7	32	102,0	83,7	92	148,4	121,8	52	194,7	159,8
13	10,1	08,2	73	56,4	46,3	33	102,8	84,3	93	149,1	122,4	53	195,5	160,4
14	10,8	08,9	74	57,2	46,9	34	103,6	85,0	94	149,9	123,0	54	196,3	161,1
15	11,6	09,5	75	58,0	47,6	35	104,3	85,6	95	150,7	123,7	55	197,1	161,7
16	12,4	10,2	76	58,7	48,2	36	105,1	86,2	96	151,5	124,3	56	197,8	162,3
17	13,1	10,8	77	59,5	48,8	37	105,9	86,9	97	152,2	124,9	57	198,6	163,0
18	13,9	11,4	78	60,3	49,5	38	106,6	87,5	98	153,0	125,6	58	199,4	163,6
19	14,7	12,0	79	61,1	50,1	39	107,4	88,1	99	153,8	126,2	59	200,1	164,1
20	15,5	12,7	80	61,8	50,7	40	108,2	88,8	200	154,6	126,8	60	200,9	164,9
21	16,2	13,3	81	62,6	51,4	41	109,0	89,4	201	155,3	127,5	261	201,7	165,5
22	17,0	14,0	82	63,4	52,0	42	109,7	90,0	02	156,1	128,1	62	202,5	166,1
23	17,8	14,6	83	64,1	52,6	43	110,5	90,7	03	156,9	128,7	63	203,2	166,8
24	18,5	15,2	84	64,9	53,3	44	111,3	91,3	04	157,6	129,4	64	204,0	167,4
25	19,3	15,8	85	65,7	53,9	45	112,1	92,0	05	158,4	130,0	65	204,8	168,0
26	20,1	16,5	86	66,5	54,5	46	112,8	92,6	06	159,2	130,6	66	205,6	168,7
27	20,9	17,1	87	67,2	55,2	47	113,6	93,2	07	160,0	131,3	67	206,3	169,3
28	21,6	17,8	88	68,0	55,8	48	114,4	93,9	08	160,7	131,9	68	207,1	170,0
29	22,4	18,4	89	68,8	56,4	49	115,1	94,5	09	161,5	132,5	69	207,9	170,6
30	23,2	19,0	90	69,6	57,1	50	115,9	95,1	10	162,3	133,2	70	208,6	171,2
31	24,0	19,7	91	70,3	57,7	151	116,7	95,8	211	163,1	133,8	271	209,4	171,9
32	24,7	20,3	92	71,1	58,3	52	117,5	96,4	12	163,8	134,4	72	210,2	172,5
33	25,5	20,9	93	71,9	59,0	53	118,2	97,0	13	164,6	135,1	73	211,0	173,1
34	26,3	21,6	94	72,6	59,6	54	119,0	97,7	14	165,4	135,7	74	211,7	173,8
35	27,1	22,2	95	73,4	60,2	55	119,8	98,3	15	166,1	136,3	75	212,5	174,4
36	27,8	22,8	96	74,2	60,9	56	120,6	98,9	16	166,9	137,0	76	213,3	175,0
37	28,6	23,5	97	75,0	61,5	57	121,3	99,6	17	167,7	137,6	77	214,1	175,7
38	29,4	24,1	98	75,7	62,1	58	122,1	100,2	18	168,5	138,2	78	214,8	176,3
39	30,1	24,7	99	76,5	62,8	59	122,9	100,8	19	169,2	138,9	79	215,6	176,9
40	30,9	25,4	100	77,3	63,4	60	123,6	101,5	20	170,0	139,5	80	216,4	177,6
41	31,7	26,0	101	78,1	64,0	101	124,4	102,1	221	170,8	140,1	281	217,1	178,2
42	32,5	26,6	02	78,8	64,7	62	125,2	102,7	22	171,6	140,8	82	217,9	178,8
43	33,2	27,3	03	79,6	65,3	63	126,0	103,4	23	172,3	141,4	83	218,7	179,5
44	34,0	27,9	04	80,4	66,0	64	126,7	104,0	24	173,1	142,0	84	219,5	180,1
45	34,8	28,5	05	81,1	66,6	65	127,5	104,6	25	173,9	142,7	85	220,2	180,7
46	35,6	29,2	06	81,9	67,2	66	128,3	105,3	26	174,6	143,3	86	221,0	181,4
47	36,3	29,8	07	82,7	67,9	67	129,1	105,9	27	175,4	144,0	87	221,8	182,0
48	37,1	30,4	08	83,5	68,5	68	129,8	106,5	28	176,2	144,6	88	222,6	182,6
49	37,9	31,1	09	84,2	69,1	69	130,6	107,2	29	177,0	145,2	89	223,3	183,3
50	38,6	31,7	10	85,0	69,8	70	131,4	107,8	30	177,7	145,9	90	224,1	183,9
51	39,4	32,3	111	85,8	70,4	171	132,1	108,4	231	178,5	146,5	291	224,9	184,5
52	40,2	33,0	12	86,6	71,0	72	132,9	109,1	32	179,3	147,1	92	225,6	185,2
53	41,0	33,6	13	87,3	71,7	73	133,7	109,7	33	180,1	147,8	93	226,4	185,8
54	41,7	34,2	14	88,1	72,3	74	134,5	110,3	34	180,8	148,4	94	227,2	186,4
55	42,5	34,9	15	88,9	72,9	75	135,2	111,0	35	181,6	149,0	95	228,0	187,1
56	43,3	35,5	16	89,6	73,6	76	136,0	111,6	36	182,4	149,7	96	228,7	187,7
57	44,1	36,1	17	90,4	74,2	77	136,8	112,2	37	183,1	150,3	97	229,5	188,3
58	44,8	36,8	18	91,2	74,8	78	137,6	112,9	38	183,9	150,9	98	230,3	189,0
59	45,6	37,4	19	92,0	75,5	79	138,3	113,5	39	184,7	151,6	99	231,1	189,6
60	46,4	38,0	20	92,7	76,1	80	139,1	114,1	40	185,5	152,2	300	231,8	190,2
Dist	D-p.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 4 1/2 Points.

Difference of Latitude and Departure for $3\frac{1}{4}$ Points.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00,7	00,7	61	45,2	41,0	121	89,6	81,2	181	134,1	121,5	241	178,5	161,8
2	01,5	01,3	62	45,9	41,6	22	90,4	81,9	82	134,8	122,2	42	179,3	162,5
3	02,2	02,0	63	46,7	42,3	23	91,1	82,6	83	135,6	122,9	43	180,0	163,2
4	03,0	02,7	64	47,4	43,0	24	91,9	83,3	84	136,3	123,5	44	180,7	163,8
5	03,7	03,4	65	48,2	43,6	25	92,6	83,9	85	137,0	124,2	45	181,5	164,5
6	04,4	04,0	66	48,9	44,3	26	93,3	84,6	86	137,8	124,9	46	182,2	165,2
7	05,2	04,7	67	49,6	45,0	27	94,1	85,3	87	138,5	125,6	47	183,0	165,8
8	05,9	05,4	68	50,4	45,7	28	94,8	85,9	88	139,3	126,2	48	183,7	166,5
9	06,7	06,0	69	51,1	46,3	29	95,6	86,6	89	140,0	126,9	49	184,4	167,2
10	07,4	06,7	70	51,9	47,0	30	96,3	87,2	90	140,7	127,6	50	185,2	167,9
11	08,2	07,4	71	52,6	47,7	131	97,0	88,0	191	141,5	128,2	251	185,9	168,5
12	08,9	08,1	72	53,3	48,3	32	97,8	88,6	92	142,2	128,9	52	186,7	169,2
13	09,6	08,7	73	54,1	49,0	33	98,5	89,3	93	143,0	129,6	53	187,4	169,9
14	10,4	09,4	74	54,8	49,7	34	99,3	90,0	94	143,7	130,3	54	188,2	170,5
15	11,1	10,1	75	55,6	50,4	35	100,0	90,6	95	144,4	130,9	55	188,9	171,2
16	11,9	10,7	76	56,3	51,0	36	100,7	91,3	96	145,2	131,6	56	189,6	171,9
17	12,6	11,4	77	57,0	51,7	37	101,5	92,0	97	145,9	132,3	57	190,4	172,6
18	13,3	12,1	78	57,8	52,4	38	102,2	92,7	98	146,7	132,9	58	191,1	173,2
19	14,1	12,8	79	58,5	53,0	39	103,0	93,3	99	147,4	133,6	59	191,9	173,9
20	14,8	13,4	80	59,3	53,7	40	103,7	94,0	200	148,2	134,3	60	192,6	174,6
21	15,6	14,1	81	60,0	54,4	141	104,4	94,7	201	148,9	135,0	261	193,3	175,2
22	16,3	14,8	82	60,7	55,1	42	105,2	95,3	02	149,6	135,6	62	194,1	175,9
23	17,0	15,4	83	61,5	55,7	43	105,9	96,0	03	150,4	136,3	63	194,8	176,6
24	17,8	16,1	84	62,2	56,4	44	106,7	96,7	04	151,1	137,0	64	195,6	177,3
25	18,5	16,8	85	63,0	57,1	45	107,4	97,4	05	151,9	137,6	65	196,3	177,9
26	19,3	17,5	86	63,7	57,7	46	108,2	98,0	06	152,6	138,3	66	197,0	178,6
27	20,0	18,1	87	64,4	58,4	47	108,9	98,7	07	153,3	139,0	67	197,8	179,3
28	20,7	18,8	88	65,2	59,1	48	109,6	99,4	08	154,1	139,7	68	198,5	179,9
29	21,5	19,5	89	65,9	59,8	49	110,4	100,0	09	155,8	140,3	69	199,3	180,6
30	22,3	20,1	90	66,7	60,4	50	111,1	100,7	10	155,6	141,0	70	200,0	181,3
31	23,0	20,8	91	67,4	61,1	151	111,9	101,4	211	156,3	141,7	271	200,7	182,0
32	23,7	21,5	92	68,2	61,8	52	112,6	102,1	12	157,0	142,3	72	201,5	182,6
33	24,4	22,2	93	68,9	62,4	53	113,3	102,7	13	157,8	143,0	73	202,2	183,3
34	25,2	22,8	94	69,6	63,1	54	114,1	103,4	14	158,5	143,7	74	203,0	184,0
35	25,9	23,5	95	70,4	63,8	55	114,8	104,1	15	159,3	144,4	75	203,7	184,6
36	26,7	24,2	96	71,1	64,5	56	115,6	104,7	16	160,0	145,0	76	204,4	185,3
37	27,4	24,8	97	71,9	65,1	57	116,3	105,4	17	160,7	145,7	77	205,2	186,0
38	28,2	25,5	98	72,6	65,8	58	117,0	106,1	18	161,5	146,4	78	205,9	186,7
39	28,9	26,2	99	73,3	66,5	59	117,8	106,8	19	162,2	147,0	79	206,7	187,3
40	29,6	26,9	100	74,1	67,1	60	118,5	107,4	20	163,0	147,7	80	207,4	188,0
41	30,4	27,5	101	74,8	67,8	161	119,3	108,1	221	163,7	148,4	281	208,2	188,7
42	31,1	28,2	02	75,6	68,5	62	120,0	108,8	22	164,4	149,1	82	208,9	189,3
43	31,9	28,9	03	76,3	69,2	63	120,7	109,4	23	165,2	149,7	83	209,6	190,0
44	32,6	29,5	04	77,0	69,8	64	121,5	110,1	24	165,9	150,4	84	210,4	190,7
45	33,3	30,2	05	77,8	70,5	65	122,2	110,8	25	166,7	151,1	85	211,1	191,4
46	34,1	30,9	06	78,5	71,2	66	123,0	111,5	26	167,4	151,7	86	211,9	192,0
47	34,8	31,6	07	79,3	71,8	67	123,7	112,1	27	168,2	152,4	87	212,6	192,7
48	35,6	32,2	08	80,0	72,5	68	124,4	112,8	28	168,9	153,1	88	213,3	193,4
49	36,3	32,9	09	80,7	73,2	69	125,2	113,5	29	169,6	153,8	89	214,1	194,0
50	37,0	33,6	10	81,5	73,9	70	125,9	114,1	30	170,4	154,4	90	214,8	194,7
51	37,8	34,2	111	82,2	74,5	171	126,7	114,8	231	171,1	155,1	291	215,6	195,4
52	38,5	34,9	12	83,0	75,2	72	127,4	115,5	32	171,9	155,8	92	216,0	196,1
53	39,3	35,6	13	83,7	75,9	73	128,2	116,2	33	172,6	156,4	93	217,3	196,7
54	40,0	36,3	14	84,4	76,5	74	128,9	116,8	34	173,3	157,1	94	217,8	197,4
55	40,7	36,9	15	85,2	77,2	75	129,6	117,5	35	174,1	157,8	95	218,5	198,1
56	41,5	37,6	16	85,9	77,9	76	130,4	118,2	36	174,8	158,5	96	219,3	198,7
57	42,2	38,3	17	86,7	78,6	77	131,1	118,8	37	175,6	159,1	97	220,0	199,4
58	43,0	38,9	18	87,4	79,2	78	131,9	119,5	38	176,3	159,8	98	220,7	200,1
59	43,7	39,6	19	88,2	79,9	79	132,6	120,2	39	177,0	160,5	99	221,5	200,8
60	44,5	40,3	20	88,9	80,6	80	133,3	120,9	40	177,8	161,1	300	222,2	201,4
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for $4\frac{1}{2}$ Points.

Difference of Latitude and Departure for 4 Points.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00,7	00,7	61	43,1	43,1	121	85,6	85,6	181	128,0	128,0	241	170,4	170,4
2	01,4	01,4	62	43,8	43,8	122	86,3	86,3	82	128,7	128,7	42	171,1	171,1
3	02,1	02,1	63	44,5	44,5	23	87,0	87,0	83	129,4	129,4	43	171,8	171,8
4	02,8	02,8	64	45,3	45,3	24	87,7	87,7	84	130,1	130,1	44	172,5	172,5
5	03,5	03,5	65	46,0	46,0	25	88,4	88,4	85	130,8	130,8	45	173,2	173,2
6	04,2	04,2	66	46,7	46,7	26	89,1	89,1	86	131,5	131,5	46	173,9	173,9
7	04,9	04,9	67	47,4	47,4	27	89,8	89,8	87	132,1	132,1	47	174,6	174,6
8	05,7	05,7	68	48,1	48,1	28	90,5	90,5	88	132,9	132,9	48	175,4	175,4
9	06,4	06,4	69	48,8	48,8	29	91,2	91,2	89	133,6	133,6	49	176,1	176,1
10	07,1	07,1	70	49,5	49,5	30	91,9	91,9	90	134,3	134,3	50	176,8	176,8
11	07,8	07,8	71	50,2	50,2	131	92,6	92,6	191	135,1	135,1	251	177,5	177,5
12	08,5	08,5	72	50,9	50,9	32	93,3	93,3	92	135,8	135,8	52	178,2	178,2
13	09,2	09,2	73	51,6	51,6	33	94,0	94,0	93	136,5	136,5	53	178,9	178,9
14	09,9	09,9	74	52,3	52,3	34	94,7	94,7	94	137,2	137,2	54	179,6	179,6
15	10,6	10,6	75	53,0	53,0	35	95,5	95,5	95	137,9	137,9	55	180,3	180,3
16	11,3	11,3	76	53,7	53,7	36	96,2	96,2	96	138,6	138,6	56	181,0	181,0
17	12,0	12,0	77	54,4	54,4	37	96,9	96,9	97	139,3	139,3	57	181,7	181,7
18	12,7	12,7	78	55,2	55,2	38	97,6	97,6	98	140,0	140,0	58	182,4	182,4
19	13,4	13,4	79	55,9	55,9	39	98,3	98,3	99	140,7	140,7	59	183,1	183,1
20	14,1	14,1	80	56,6	56,6	40	99,0	99,0	200	141,4	141,4	60	183,8	183,8
21	14,8	14,8	81	57,3	57,3	141	99,7	99,7	201	142,1	142,1	261	184,5	184,5
22	15,6	15,6	82	58,0	58,0	42	100,4	100,4	02	142,8	142,8	62	185,3	185,3
23	16,3	16,3	83	58,7	58,7	43	101,1	101,1	03	143,5	143,5	63	186,0	186,0
24	17,0	17,0	84	59,4	59,4	44	101,8	101,8	04	144,2	144,2	64	186,7	186,7
25	17,7	17,7	85	60,1	60,1	45	102,5	102,5	05	144,9	144,9	65	187,4	187,4
26	18,4	18,4	86	60,8	60,8	46	103,2	103,2	06	145,7	145,7	66	188,1	188,1
27	19,1	19,1	87	61,5	61,5	47	103,9	103,9	07	146,4	146,4	67	188,8	188,8
28	19,8	19,8	88	62,2	62,2	48	104,6	104,6	08	147,1	147,1	68	189,5	189,5
29	20,5	20,5	89	62,9	62,9	49	105,4	105,4	09	147,8	147,8	69	190,2	190,2
30	21,2	21,2	90	63,6	63,6	50	106,1	106,1	10	148,5	148,5	70	190,9	190,9
31	21,9	21,9	91	64,3	64,3	151	106,8	106,8	211	149,2	149,2	271	191,6	191,6
32	22,6	22,6	92	65,1	65,1	52	107,5	107,5	12	149,9	149,9	72	192,3	192,3
33	23,3	23,3	93	65,8	65,8	53	108,2	108,2	13	150,6	150,6	73	193,0	193,0
34	24,0	24,0	94	66,5	66,5	54	108,9	108,9	14	151,3	151,3	74	193,7	193,7
35	24,7	24,7	95	67,2	67,2	55	109,6	109,6	15	152,0	152,0	75	194,4	194,4
36	25,5	25,5	96	67,9	67,9	56	110,3	110,3	16	152,7	152,7	76	195,2	195,2
37	26,2	26,2	97	68,6	68,6	57	111,0	111,0	17	153,4	153,4	77	195,9	195,9
38	26,9	26,9	98	69,3	69,3	58	111,7	111,7	18	154,1	154,1	78	196,6	196,6
39	27,6	27,6	99	70,0	70,0	59	112,4	112,4	19	155,8	155,8	79	197,3	197,3
40	28,3	28,3	100	70,7	70,7	60	113,1	113,1	20	156,6	156,6	80	198,0	198,0
41	29,0	29,0	101	71,4	71,4	161	113,8	113,8	221	156,3	156,3	281	198,7	198,7
42	29,7	29,7	02	72,1	72,1	62	114,5	114,5	22	157,0	157,0	82	199,4	199,4
43	30,4	30,4	03	72,8	72,8	63	115,3	115,3	23	157,7	157,7	83	200,1	200,1
44	31,1	31,1	04	73,5	73,5	64	116,0	116,0	24	158,4	158,4	84	200,8	200,8
45	31,8	31,8	05	74,2	74,2	65	116,7	116,7	25	159,1	159,1	85	201,5	201,5
46	32,5	32,5	06	74,9	74,9	66	117,4	117,4	26	159,8	159,8	86	202,2	202,2
47	33,2	33,2	07	75,7	75,7	67	118,1	118,1	27	160,5	160,5	87	202,9	202,9
48	33,9	33,9	08	76,4	76,4	68	118,8	118,8	28	161,2	161,2	88	203,6	203,6
49	34,6	34,6	09	77,1	77,1	69	119,5	119,5	29	161,9	161,9	89	204,3	204,3
50	35,4	35,4	10	77,8	77,8	70	120,2	120,2	30	162,6	162,6	90	205,1	205,1
51	36,1	36,1	111	78,5	78,5	171	120,9	120,9	231	163,3	163,3	291	205,8	205,8
52	36,8	36,8	12	79,2	79,2	72	121,6	121,6	32	164,0	164,0	92	206,5	206,5
53	37,5	37,5	13	79,9	79,9	73	122,3	122,3	33	164,7	164,7	93	207,2	207,2
54	38,2	38,2	14	80,6	80,6	74	123,0	123,0	34	165,5	165,5	94	207,9	207,9
55	38,9	38,9	15	81,3	81,3	75	123,7	123,7	35	166,2	166,2	95	208,6	208,6
56	39,6	39,6	16	82,0	82,0	76	124,4	124,4	36	166,9	166,9	96	209,3	209,3
57	40,3	40,3	17	82,7	82,7	77	125,2	125,2	37	167,6	167,6	97	210,0	210,0
58	41,0	41,0	18	83,4	83,4	78	125,9	125,9	38	168,3	168,3	98	210,7	210,7
59	41,7	41,7	19	84,1	84,1	79	126,6	126,6	39	169,0	169,0	99	211,4	211,4
60	42,4	42,4	20	84,8	84,8	80	127,3	127,3	40	169,7	169,7	300	212,1	212,1
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Lat.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 4 Points.

Difference of Latitude and Departure for 1 Deg.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01,0	00,0	61	61,0	01,1	121	121,0	02,1	181	181,0	03,1	241	241,0	04,1
2	02,0	00,0	62	62,0	01,1	22	122,0	02,1	82	182,0	03,1	42	242,0	04,2
3	03,0	00,1	63	63,0	01,1	23	123,0	02,1	83	183,0	03,2	43	243,0	04,2
4	04,0	00,1	64	64,0	01,1	24	124,0	02,2	84	184,0	03,2	44	244,0	04,2
5	05,0	00,1	65	65,0	01,1	25	125,0	02,2	85	185,0	03,2	45	245,0	04,2
6	06,0	00,1	66	66,0	01,2	26	126,0	02,2	86	186,0	03,2	46	246,0	04,2
7	07,0	00,1	67	67,0	01,2	27	127,0	02,2	87	187,0	03,2	47	247,0	04,2
8	08,0	00,1	68	68,0	01,2	28	128,0	02,2	88	188,0	03,2	48	248,0	04,3
9	09,0	00,2	69	69,0	01,2	29	129,0	02,2	89	189,0	03,3	49	249,0	04,3
10	10,0	00,2	70	70,0	01,2	30	130,0	02,3	90	190,0	03,3	50	250,0	04,3
11	11,0	00,2	71	71,0	01,2	131	131,0	02,3	191	191,0	03,3	251	251,0	04,3
12	12,0	00,2	72	72,0	01,3	32	132,0	02,3	92	192,0	03,3	52	252,0	04,3
13	13,0	00,2	73	73,0	01,3	33	133,0	02,3	93	193,0	03,3	53	253,0	04,3
14	14,0	00,2	74	74,0	01,3	34	134,0	02,3	94	194,0	03,3	54	254,0	04,4
15	15,0	00,3	75	75,0	01,3	35	135,0	02,3	95	195,0	03,4	55	255,0	04,4
16	16,0	00,3	76	76,0	01,3	36	136,0	02,4	96	196,0	03,4	56	256,0	04,4
17	17,0	00,3	77	77,0	01,3	37	137,0	02,4	97	197,0	03,4	57	257,0	04,4
18	18,0	00,3	78	78,0	01,4	38	138,0	02,4	98	198,0	03,4	58	258,0	04,4
19	19,0	00,3	79	79,0	01,4	39	139,0	02,4	99	199,0	03,4	59	259,0	04,4
20	20,0	00,4	80	80,0	01,4	40	140,0	02,4	200	200,0	03,4	60	260,0	04,5
21	21,0	00,4	81	81,0	01,4	141	141,0	02,4	201	201,0	03,5	261	261,0	04,5
22	22,0	00,4	82	82,0	01,4	42	142,0	02,5	02	202,0	03,5	62	262,0	04,5
23	23,0	00,4	83	83,0	01,5	43	143,0	02,5	03	203,0	03,5	63	263,0	04,5
24	24,0	00,4	84	84,0	01,5	44	144,0	02,5	04	204,0	03,5	64	264,0	04,5
25	25,0	00,4	85	85,0	01,5	45	145,0	02,5	05	205,0	03,5	65	265,0	04,6
26	26,0	00,5	86	86,0	01,5	46	146,0	02,5	06	206,0	03,5	66	266,0	04,6
27	27,0	00,5	87	87,0	01,5	47	147,0	02,5	07	207,0	03,6	67	267,0	04,6
28	28,0	00,5	88	88,0	01,5	48	148,0	02,5	08	208,0	03,6	68	268,0	04,6
29	29,0	00,5	89	89,0	01,6	49	149,0	02,6	09	209,0	03,6	69	269,0	04,6
30	30,0	00,5	90	90,0	01,6	50	150,0	02,6	10	210,0	03,6	70	270,0	04,6
31	31,0	00,5	91	91,0	01,6	151	151,0	02,6	211	211,0	03,6	271	271,0	04,7
32	32,0	00,6	92	92,0	01,6	52	152,0	02,6	12	212,0	03,6	72	272,0	04,7
33	33,0	00,6	93	93,0	01,6	53	153,0	02,7	13	213,0	03,7	73	273,0	04,7
33	34,0	00,6	94	94,0	01,6	54	154,0	02,7	14	214,0	03,7	74	274,0	04,7
35	35,0	00,6	95	95,0	01,7	55	155,0	02,7	15	215,0	03,7	75	275,0	04,7
36	36,0	00,6	96	96,0	01,7	56	156,0	02,7	16	216,0	03,7	76	276,0	04,7
37	37,0	00,6	97	97,0	01,7	57	157,0	02,7	17	217,0	03,7	77	277,0	04,8
38	38,0	00,7	98	98,0	01,7	58	158,0	02,7	18	218,0	03,8	78	278,0	04,8
39	39,0	00,7	99	99,0	01,7	59	159,0	02,7	19	219,0	03,8	79	279,0	04,8
40	40,0	00,7	100	100,0	01,7	60	160,0	02,8	20	220,0	03,8	80	280,0	04,8
41	41,0	00,7	101	101,0	01,8	161	161,0	02,8	221	221,0	03,8	281	281,0	04,8
42	42,0	00,7	02	102,0	01,8	62	162,0	02,8	22	222,0	03,8	82	282,0	04,8
43	43,0	00,8	03	103,0	01,8	63	163,0	02,8	23	223,0	03,8	83	283,0	04,9
44	44,0	00,8	04	104,0	01,8	64	164,0	02,8	24	224,0	03,9	84	284,0	04,9
45	45,0	00,8	05	105,0	01,8	65	165,0	02,9	25	225,0	03,9	85	285,0	04,9
46	46,0	00,8	06	106,0	01,8	66	166,0	02,9	26	226,0	03,9	86	286,0	04,9
47	47,0	00,8	07	107,0	01,9	67	167,0	02,9	27	227,0	03,9	87	287,0	04,9
48	48,0	00,8	08	108,0	01,9	68	168,0	02,9	28	228,0	03,9	88	288,0	04,9
49	49,0	00,9	09	109,0	01,9	69	169,0	02,9	29	229,0	03,9	89	289,0	05,0
50	50,0	00,9	10	110,0	01,9	70	170,0	02,9	30	230,0	04,0	290	290,0	05,0
51	51,0	00,9	111	111,0	01,9	171	171,0	03,0	231	231,0	04,0	291	291,0	05,0
52	52,0	00,9	12	112,0	01,9	72	172,0	03,0	32	232,0	04,0	92	292,0	05,0
53	53,0	00,9	13	113,0	02,0	73	173,0	03,0	33	233,0	04,0	93	293,0	05,0
54	54,0	00,9	14	114,0	02,0	74	174,0	03,0	34	234,0	04,0	94	294,0	05,0
55	55,0	01,0	15	115,0	02,0	75	175,0	03,0	35	235,0	04,0	95	295,0	05,1
56	56,0	01,0	16	116,0	02,0	76	176,0	03,0	36	236,0	04,1	96	296,0	05,1
57	57,0	01,0	17	117,0	02,0	77	177,0	03,1	37	237,0	04,1	97	297,0	05,1
58	58,0	01,0	18	118,0	02,1	78	178,0	03,1	38	238,0	04,1	98	298,0	05,1
59	59,0	01,0	19	119,0	02,1	79	179,0	03,1	39	239,0	04,1	99	299,0	05,1
60	60,0	01,1	20	120,0	02,1	80	180,0	03,1	40	240,0	04,1	300	300,0	05,1
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

[c]

for 89 Deg.

Difference of Latitude and Departure for 2 Deg.

Lat.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01,0	00,0	61	61,0	02,1	121	120,9	04,2	181	180,9	06,3	241	240,9	08,4
2	02,0	00,1	62	62,0	02,2	22	121,9	04,3	82	181,9	06,4	42	241,9	08,5
3	03,0	00,1	63	63,0	02,2	23	122,9	04,3	83	182,9	06,4	43	242,9	08,5
4	04,0	00,1	64	64,0	02,2	24	123,9	04,3	84	183,9	06,4	44	243,9	08,5
5	05,0	00,2	65	65,0	02,3	25	124,9	04,4	85	184,9	06,5	45	244,9	08,6
6	06,0	00,2	66	66,0	02,3	26	125,9	04,4	86	185,9	06,5	46	245,9	08,6
7	07,0	00,2	67	67,0	02,3	27	126,9	04,4	87	186,9	06,5	47	246,9	08,6
8	08,0	00,3	68	68,0	02,4	28	127,9	04,5	88	187,9	06,6	48	247,9	08,7
9	09,0	00,3	69	69,0	02,4	29	128,9	04,5	89	188,9	06,6	49	248,9	08,7
10	10,0	00,4	70	70,0	02,4	30	129,9	04,6	90	189,9	06,7	50	249,9	08,8
11	11,0	00,4	71	71,0	02,5	131	130,9	04,6	191	190,9	06,7	251	250,8	08,8
12	12,0	00,4	72	72,0	02,5	32	131,9	04,6	92	191,9	06,7	52	251,8	08,8
13	13,0	00,5	73	73,0	02,5	33	132,9	04,7	93	192,9	06,8	53	252,8	08,9
14	14,0	00,5	74	74,0	02,6	34	133,9	04,7	94	193,9	06,8	54	253,8	08,9
15	15,0	00,5	75	75,0	02,6	35	134,9	04,7	95	194,9	06,8	55	254,8	08,9
16	16,0	00,6	76	76,0	02,7	36	135,9	04,8	96	195,9	06,9	56	255,8	09,0
17	17,0	00,6	77	77,0	02,7	37	136,9	04,8	97	196,9	06,9	57	256,8	09,0
18	18,0	00,6	78	78,0	02,7	38	137,9	04,8	98	197,9	06,9	58	257,8	09,0
19	19,0	00,7	79	79,0	02,8	39	138,9	04,9	99	198,9	07,0	59	258,8	09,1
20	20,0	00,7	80	80,0	02,8	40	139,9	04,9	200	199,9	07,0	60	259,8	09,1
21	21,0	00,7	81	81,0	02,8	141	140,9	04,9	201	200,9	07,0	261	260,8	09,1
22	22,0	00,8	82	81,9	02,9	42	141,9	05,0	02	201,9	07,1	62	261,8	09,2
23	23,0	00,8	83	82,9	02,9	43	142,9	05,0	03	202,9	07,1	63	262,8	09,2
24	24,0	00,8	84	83,9	02,9	44	143,9	05,0	04	203,9	07,1	64	263,8	09,2
25	25,0	00,9	85	84,9	03,0	45	144,9	05,1	05	204,9	07,2	65	264,8	09,3
26	26,0	00,9	86	85,9	03,0	46	145,9	05,1	06	205,9	07,2	66	265,8	09,3
27	27,0	00,9	87	86,9	03,0	47	146,9	05,1	07	206,9	07,2	67	266,8	09,3
28	28,0	01,0	88	87,9	03,1	48	147,9	05,2	08	207,9	07,3	68	267,8	09,4
29	29,0	01,0	89	88,9	03,1	49	148,9	05,2	09	208,9	07,3	69	268,8	09,4
30	30,0	01,1	90	89,9	03,1	50	149,9	05,3	10	209,9	07,4	70	269,8	09,5
31	31,0	01,1	91	90,9	03,2	151	150,9	05,3	211	210,9	07,4	271	270,8	09,5
32	32,0	01,1	92	91,9	03,2	52	151,9	05,3	12	211,9	07,4	72	271,8	09,5
33	33,0	01,2	93	92,9	03,2	53	152,9	05,4	13	212,9	07,5	73	272,8	09,6
34	34,0	01,2	94	93,9	03,3	54	153,9	05,4	14	213,9	07,5	74	273,8	09,6
35	35,0	01,2	95	94,9	03,3	55	154,9	05,4	15	214,9	07,5	75	274,8	09,6
36	36,0	01,3	96	95,9	03,4	56	155,9	05,5	16	215,9	07,6	76	275,8	09,7
37	37,0	01,3	97	96,9	03,4	57	156,9	05,5	17	216,9	07,6	77	276,8	09,7
38	38,0	01,3	98	97,9	03,4	58	157,9	05,5	18	217,9	07,6	78	277,8	09,7
39	39,0	01,4	99	98,9	03,5	59	158,9	05,6	19	218,9	07,7	79	278,8	09,8
40	40,0	01,4	100	99,9	03,5	60	159,9	05,6	20	219,9	07,7	80	279,8	09,8
41	41,0	01,4	101	100,9	03,5	161	160,9	05,6	221	220,9	07,7	281	280,8	09,8
42	42,0	01,5	02	101,9	03,6	62	161,9	05,7	22	221,9	07,8	82	281,8	09,9
43	43,0	01,5	03	102,9	03,6	63	162,9	05,7	23	222,9	07,8	83	282,8	09,9
44	44,0	01,5	04	103,9	03,6	64	163,9	05,7	24	223,9	07,8	84	283,8	09,9
45	45,0	01,6	05	104,9	03,7	65	164,9	05,8	25	224,9	07,9	85	284,8	10,0
46	46,0	01,6	06	105,9	03,7	66	165,9	05,8	26	225,9	07,9	86	285,8	10,0
47	47,0	01,6	07	106,9	03,7	67	166,9	05,8	27	226,9	07,9	87	286,8	10,0
48	48,0	01,7	08	107,9	03,8	68	167,9	05,9	28	227,9	08,0	88	287,8	10,1
49	49,0	01,7	09	108,9	03,8	69	168,9	05,9	29	228,9	08,0	89	288,8	10,1
50	50,0	01,7	10	109,9	03,9	70	169,9	06,0	30	229,9	08,1	90	289,8	10,2
51	51,0	01,8	111	110,9	03,9	171	170,9	06,0	231	230,9	08,1	291	290,8	10,2
52	52,0	01,8	12	111,9	03,9	72	171,9	06,0	32	231,9	08,1	92	291,8	10,2
53	53,0	01,8	13	112,9	04,0	73	172,9	06,1	33	232,9	08,2	93	292,8	10,3
54	54,0	01,9	14	113,9	04,0	74	173,9	06,1	34	233,9	08,2	94	293,8	10,3
55	55,0	01,9	15	114,9	04,0	75	174,9	06,1	35	234,9	08,2	95	294,8	10,3
56	56,0	02,0	16	115,9	04,1	76	175,9	06,2	36	235,9	08,3	96	295,8	10,4
57	57,0	02,0	17	116,9	04,1	77	176,9	06,2	37	236,9	08,3	97	296,8	10,4
58	58,0	02,0	18	117,9	04,1	78	177,9	06,2	38	237,9	08,3	98	297,8	10,4
59	59,0	02,1	19	118,9	04,2	79	178,9	06,3	39	238,9	08,4	99	298,8	10,5
60	60,0	02,1	20	119,9	04,2	80	179,9	06,3	40	239,9	08,4	300	299,8	10,5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Difference of Latitude and Departure for 3 Deg.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01,0	00,1	61	60,9	03,2	121	120,8	06,3	181	180,7	09,5	241	240,7	12,6
2	02,0	00,1	62	61,9	03,2	22	121,8	06,4	82	181,7	09,5	42	241,7	12,7
3	03,0	00,2	63	62,9	03,3	23	122,8	06,4	83	182,7	09,6	43	242,7	12,7
4	04,0	00,2	64	63,9	03,3	24	123,8	06,5	84	183,7	09,6	44	243,7	12,8
5	05,0	00,3	65	64,9	03,4	25	124,8	06,5	85	184,7	09,7	45	244,7	12,8
6	06,0	00,3	66	65,9	03,5	26	125,8	06,6	86	185,7	09,7	46	245,7	12,9
7	07,0	00,4	67	66,9	03,5	27	126,8	06,6	87	186,7	09,8	47	246,7	12,9
8	08,0	00,4	68	67,9	03,6	28	127,8	06,7	88	187,7	09,8	48	247,7	13,0
9	09,0	00,5	69	68,9	03,6	29	128,8	06,8	89	188,7	09,9	49	248,7	13,0
10	10,0	00,5	70	69,9	03,7	30	129,8	06,8	90	189,7	09,9	50	249,7	13,1
11	11,0	00,6	71	70,9	03,7	131	130,8	06,9	191	190,7	10,0	251	250,6	13,1
12	12,0	00,6	72	71,9	03,8	32	131,8	06,9	92	191,7	10,0	52	251,6	13,2
13	13,0	00,7	73	72,9	03,8	33	132,8	07,0	93	192,7	10,1	53	252,6	13,2
14	14,0	00,7	74	73,9	03,9	34	133,8	07,0	94	193,7	10,1	54	253,6	13,3
15	15,0	00,8	75	74,9	03,9	35	134,8	07,1	95	194,7	10,2	55	254,6	13,3
16	16,0	00,8	76	75,9	04,0	36	135,8	07,1	96	195,7	10,3	56	255,6	13,4
17	17,0	00,9	77	76,9	04,0	37	136,8	07,2	97	196,7	10,3	57	256,6	13,4
18	18,0	00,9	78	77,9	04,1	38	137,8	07,2	98	197,7	10,4	58	257,6	13,5
19	19,0	01,0	79	78,9	04,1	39	138,8	07,3	99	198,7	10,4	59	258,6	13,6
20	20,0	01,0	80	79,9	04,2	40	139,8	07,3	200	199,7	10,5	60	259,6	13,6
21	21,0	01,1	81	80,9	04,2	141	140,8	07,4	201	200,7	10,5	261	260,6	13,7
22	22,0	01,1	82	81,9	04,3	42	141,8	07,4	02	201,7	10,6	62	261,6	13,7
23	23,0	01,2	83	82,9	04,3	43	142,8	07,5	03	202,7	10,6	63	262,6	13,8
24	24,0	01,3	84	83,9	04,4	44	143,8	07,5	04	203,7	10,7	64	263,6	13,8
25	25,0	01,3	85	84,9	04,4	45	144,8	07,6	05	204,7	10,7	65	264,6	13,9
26	26,0	01,4	86	85,9	04,5	46	145,8	07,6	06	205,7	10,8	66	265,6	13,9
27	27,0	01,4	87	86,9	04,6	47	146,8	07,7	07	206,7	10,8	67	266,6	14,0
28	28,0	01,5	88	87,9	04,6	48	147,8	07,7	08	207,7	10,9	68	267,6	14,0
29	29,0	01,5	89	88,9	04,7	49	148,8	07,8	09	208,7	10,9	69	268,6	14,1
30	30,0	01,6	90	89,9	04,7	50	149,8	07,9	10	209,7	11,0	70	269,6	14,1
31	31,0	01,6	91	90,9	04,8	151	150,8	07,9	211	210,7	11,0	271	270,6	14,2
32	32,0	01,7	92	91,9	04,8	52	151,8	08,0	12	211,7	11,1	72	271,6	14,2
33	33,0	01,7	93	92,9	04,9	53	152,8	08,0	13	212,7	11,1	73	272,6	14,3
34	34,0	01,8	94	93,9	04,9	54	153,8	08,1	14	213,7	11,2	74	273,6	14,3
35	35,0	01,8	95	94,9	05,0	55	154,8	08,1	15	214,7	11,2	75	274,6	14,4
36	36,0	01,9	96	95,9	05,0	56	155,8	08,2	16	215,7	11,3	76	275,6	14,4
37	37,0	02,0	97	96,9	05,1	57	156,8	08,2	17	216,7	11,4	77	276,6	14,5
38	38,0	02,0	98	97,9	05,1	58	157,8	08,3	18	217,7	11,4	78	277,6	14,5
39	39,0	02,1	99	98,9	05,2	59	158,8	08,3	19	218,7	11,5	79	278,6	14,6
40	40,0	02,1	100	99,9	05,2	60	159,8	08,4	20	219,7	11,5	80	279,6	14,7
41	40,9	02,1	101	100,9	05,3	161	160,8	08,4	221	220,7	11,6	281	280,6	14,7
42	41,9	02,2	02	101,9	05,3	62	161,8	08,5	22	221,7	11,6	82	281,6	14,8
43	42,9	02,2	03	102,9	05,4	63	162,8	08,5	23	222,7	11,7	83	282,6	14,8
44	43,9	02,3	04	103,9	05,4	64	163,8	08,6	24	223,7	11,7	84	283,6	14,9
45	44,9	02,4	05	104,9	05,5	65	164,8	08,6	25	224,7	11,8	85	284,6	14,9
46	45,9	02,4	06	105,9	05,5	66	165,8	08,7	26	225,7	11,8	86	285,6	15,0
47	46,9	02,5	07	106,9	05,6	67	166,8	08,7	27	226,7	11,9	87	286,6	15,0
48	47,9	02,5	08	107,8	05,7	68	167,8	08,8	28	227,7	11,9	88	287,6	15,1
49	48,9	02,6	09	108,8	05,7	69	168,8	08,8	29	228,7	12,0	89	288,6	15,1
50	49,9	02,6	10	109,8	05,8	70	169,8	08,9	30	229,7	12,0	90	289,6	15,2
51	50,9	02,7	111	110,8	05,8	171	170,8	09,0	231	230,7	12,1	291	290,6	15,2
52	51,9	02,7	12	111,8	05,9	72	171,8	09,0	32	231,7	12,1	92	291,6	15,3
53	52,9	02,8	13	112,8	05,9	73	172,8	09,1	33	232,7	12,2	93	292,6	15,3
54	53,9	02,8	14	113,8	06,0	74	173,8	09,1	34	233,7	12,2	94	293,6	15,4
55	54,9	02,9	15	114,8	06,0	75	174,8	09,2	35	234,7	12,3	95	294,6	15,4
56	55,9	02,9	16	115,8	06,1	76	175,8	09,2	36	235,7	12,3	96	295,6	15,5
57	56,9	03,0	17	116,8	06,1	77	176,8	09,3	37	236,7	12,4	97	296,6	15,5
58	57,9	03,0	18	117,8	06,2	78	177,8	09,3	38	237,7	12,5	98	297,6	15,6
59	58,9	03,1	19	118,8	06,2	79	178,8	09,4	39	238,7	12,5	99	298,6	15,6
60	59,9	03,1	20	119,8	06,3	80	179,8	09,4	40	239,7	12,6	300	299,6	15,7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Difference of Latitude and Departure for 4 Deg.

D. ft.	Lat.	Dep.	D. ft.	Lat.	Dep.	D. ft.	Lat.	Dep.	D. ft.	Lat.	Dep.	D. ft.	Lat.	Dep.
1	01,0	00,1	61	60,0	04,3	121	120,7	08,4	181	180,6	12,6	241	240,4	16,8
2	02,0	00,1	62	61,9	04,3	22	121,7	08,5	82	181,6	12,7	42	241,4	16,9
3	03,0	00,2	63	63,8	04,4	23	122,7	08,6	83	182,6	12,8	43	242,4	16,9
4	04,0	00,3	64	65,8	04,5	24	123,7	08,6	84	183,6	12,8	44	243,4	17,0
5	05,0	00,3	65	67,8	04,5	25	124,7	08,7	85	184,6	12,9	45	244,4	17,1
6	06,0	00,4	66	69,8	04,6	26	125,7	08,8	86	185,6	13,0	46	245,4	17,1
7	07,0	00,5	67	71,8	04,7	27	126,7	08,9	87	186,6	13,0	47	246,4	17,2
8	08,0	00,6	68	73,8	04,7	28	127,7	08,9	88	187,5	13,1	48	247,4	17,2
9	09,0	00,6	69	75,8	04,8	29	128,7	09,0	89	188,5	13,2	49	248,4	17,3
10	10,0	00,7	70	77,8	04,9	30	129,7	09,1	90	189,5	13,2	50	249,4	17,4
11	11,0	00,8	71	79,8	05,0	31	130,7	09,1	91	190,5	13,3	51	250,4	17,5
12	12,0	00,8	72	81,8	05,0	32	131,7	09,2	92	191,5	13,4	52	251,4	17,6
13	13,0	00,9	73	83,8	05,1	33	132,7	09,3	93	192,5	13,5	53	252,4	17,6
14	14,0	01,0	74	85,8	05,2	34	133,7	09,3	94	193,5	13,5	54	253,4	17,7
15	15,0	01,0	75	87,8	05,2	35	134,7	09,4	95	194,5	13,6	55	254,4	17,8
16	16,0	01,1	76	89,8	05,3	36	135,7	09,5	96	195,5	13,7	56	255,4	17,8
17	17,0	01,2	77	91,8	05,4	37	136,7	09,5	97	196,5	13,7	57	256,4	17,9
18	18,0	01,3	78	93,8	05,4	38	137,7	09,6	98	197,5	13,8	58	257,4	18,0
19	19,0	01,3	79	95,8	05,5	39	138,7	09,7	99	198,5	13,9	59	258,4	18,1
20	20,0	01,4	80	97,8	05,6	40	139,7	09,8	200	199,5	13,9	60	259,4	18,1
21	20,9	01,5	81	99,8	05,7	41	140,7	09,8	201	200,5	14,0	61	260,4	18,2
22	21,9	01,5	82	101,8	05,7	42	141,7	09,9	02	201,5	14,1	62	261,4	18,3
23	22,9	01,6	83	103,8	05,8	43	142,7	10,0	03	202,5	14,1	63	262,4	18,3
24	23,9	01,7	84	105,8	05,8	44	143,7	10,0	04	203,5	14,2	64	263,4	18,4
25	24,9	01,7	85	107,8	05,9	45	144,7	10,1	05	204,5	14,3	65	264,4	18,5
26	25,9	01,8	86	109,8	06,0	46	145,6	10,2	06	205,5	14,4	66	265,4	18,5
27	26,9	01,9	87	111,8	06,1	47	146,6	10,2	07	206,5	14,4	67	266,4	18,6
28	27,9	02,0	88	113,8	06,1	48	147,6	10,3	08	207,5	14,5	68	267,4	18,7
29	28,9	02,0	89	115,8	06,2	49	148,6	10,4	09	208,5	14,6	69	268,4	18,7
30	29,9	02,1	90	117,8	06,3	50	149,6	10,5	10	209,5	14,6	70	269,4	18,8
31	30,9	02,2	91	119,8	06,4	51	150,6	10,5	211	210,5	14,7	71	270,4	18,9
32	31,9	02,2	92	121,8	06,4	52	151,6	10,6	12	211,5	14,8	72	271,4	19,0
33	32,9	02,3	93	123,8	06,5	53	152,6	10,7	13	212,5	14,8	73	272,4	19,0
34	33,9	02,4	94	125,8	06,6	54	153,6	10,7	14	213,5	14,9	74	273,4	19,1
35	34,9	02,4	95	127,8	06,6	55	154,6	10,8	15	214,5	15,0	75	274,4	19,2
36	35,9	02,5	96	129,8	06,7	56	155,6	10,9	16	215,5	15,1	76	275,4	19,2
37	36,9	02,6	97	131,8	06,8	57	156,6	10,9	17	216,5	15,1	77	276,4	19,3
38	37,9	02,7	98	133,8	06,8	58	157,6	11,0	18	217,5	15,2	78	277,4	19,4
39	38,9	02,7	99	135,8	06,9	59	158,6	11,1	19	218,5	15,3	79	278,4	19,4
40	39,9	02,8	100	137,8	07,0	60	159,6	11,2	20	219,5	15,3	80	279,4	19,5
41	40,9	02,9	101	139,8	07,0	61	160,6	11,2	221	220,5	15,4	81	280,4	19,6
42	41,9	02,9	02	141,8	07,1	62	161,6	11,3	22	221,5	15,5	82	281,4	19,7
43	42,9	03,0	03	143,8	07,2	63	162,6	11,4	23	222,5	15,5	83	282,4	19,7
44	43,9	03,1	04	145,8	07,2	64	163,6	11,4	24	223,5	15,6	84	283,4	19,8
45	44,9	03,1	05	147,8	07,3	65	164,6	11,5	25	224,5	15,7	85	284,4	19,9
46	45,9	03,2	06	149,8	07,4	66	165,6	11,6	26	225,5	15,8	86	285,4	19,9
47	46,9	03,3	07	151,8	07,5	67	166,6	11,6	27	226,5	15,8	87	286,4	20,0
48	47,9	03,4	08	153,8	07,5	68	167,6	11,7	28	227,5	15,9	88	287,4	20,1
49	48,9	03,4	09	155,8	07,6	69	168,6	11,8	29	228,5	16,0	89	288,4	20,1
50	49,9	03,5	10	157,8	07,7	70	169,6	11,8	30	229,5	16,0	90	289,4	20,2
51	50,9	03,6	111	159,8	07,7	171	170,6	11,9	231	230,4	16,1	291	290,3	20,3
52	51,9	03,6	12	161,8	07,8	72	171,6	12,0	32	231,4	16,2	92	291,3	20,4
53	52,9	03,7	13	163,8	07,9	73	172,6	12,1	33	232,4	16,2	93	292,3	20,4
54	53,9	03,8	14	165,8	07,9	74	173,6	12,1	34	233,4	16,3	94	293,3	20,5
55	54,9	03,8	15	167,8	08,0	75	174,6	12,2	35	234,4	16,4	95	294,3	20,6
56	55,9	03,9	16	169,8	08,1	76	175,6	12,3	36	235,4	16,4	96	295,3	20,6
57	56,9	04,0	17	171,8	08,2	77	176,6	12,3	37	236,4	16,5	97	296,3	20,7
58	57,9	04,0	18	173,8	08,2	78	177,6	12,4	38	237,4	16,6	98	297,3	20,8
59	58,9	04,1	19	175,8	08,3	79	178,6	12,5	39	238,4	16,7	99	298,3	20,8
60	59,9	04,2	20	177,8	08,4	80	179,6	12,5	40	239,4	16,7	300	299,3	20,9
Diff. Dep.	Lat.		Diff. Dep.	Lat.		Diff. Dep.	Lat.		Diff. Dep.	Lat.		Diff. Dep.	Lat.	

Difference of Latitude and Departure for 5 eg.

D. ft.	Lat.	Dep.	D. ft.	Lat.	Dep.	D. ft.	Lat.	Dep.	D. ft.	Lat.	Dep.	D. ft.	Lat.	Dep.
1	01,0	00,1	61	60,8	05,3	121	120,5	10,5	181	180,3	15,7	241	240,1	21,0
2	02,0	00,2	62	61,8	05,4	22	121,5	10,6	82	181,3	15,8	42	241,1	21,1
3	03,0	00,3	63	62,8	05,5	23	122,5	10,7	83	182,3	15,9	43	242,1	21,1
4	04,0	00,3	64	63,8	05,6	24	123,5	10,8	84	183,3	16,0	44	243,1	21,2
5	05,0	00,4	65	64,8	05,7	25	124,5	10,9	85	184,3	16,1	45	244,1	21,3
6	06,0	00,5	66	65,7	05,8	26	125,5	11,0	86	185,3	16,2	46	245,1	21,4
7	07,0	00,6	67	66,7	05,8	27	126,5	11,0	87	186,3	16,3	47	246,1	21,5
8	08,0	00,7	68	67,7	05,9	28	127,5	11,1	88	187,3	16,4	48	247,1	21,6
9	09,0	00,8	69	68,7	06,0	29	128,5	11,2	89	188,3	16,4	49	248,1	21,7
10	10,0	00,9	70	69,7	06,1	30	129,5	11,3	90	189,3	16,5	50	249,1	21,8
11	11,0	01,0	71	70,7	06,2	131	130,5	11,4	191	190,3	16,6	251	250,0	21,8
12	12,0	01,0	72	71,7	06,3	32	131,5	11,5	92	191,3	16,7	52	251,0	21,9
13	12,9	01,1	73	72,7	06,4	33	132,5	11,6	93	192,3	16,8	53	252,0	22,0
14	13,9	01,2	74	73,7	06,5	34	133,5	11,7	94	193,3	16,9	54	253,0	22,1
15	14,9	01,3	75	74,7	06,6	35	134,5	11,7	95	194,3	17,0	55	254,0	22,2
16	15,9	01,4	76	75,7	06,6	36	135,5	11,8	96	195,3	17,1	56	255,0	22,3
17	16,9	01,5	77	76,7	06,7	37	136,5	11,9	97	196,3	17,1	57	256,0	22,4
18	17,9	01,6	78	77,7	06,8	38	137,5	12,0	98	197,2	17,2	58	257,0	22,4
19	18,9	01,7	79	78,7	06,9	39	138,5	12,1	99	198,2	17,3	59	258,0	22,5
20	19,9	01,7	80	79,7	07,0	40	139,5	12,2	200	199,2	17,4	60	259,0	22,6
21	20,9	01,8	81	80,7	07,1	141	140,5	12,3	201	200,2	17,5	261	260,0	22,7
22	21,9	01,9	82	81,7	07,2	42	141,5	12,4	02	201,2	17,6	62	261,0	22,8
23	22,9	02,0	83	82,7	07,2	43	142,5	12,4	03	202,2	17,7	63	262,0	22,9
24	23,9	02,1	84	83,7	07,3	44	143,5	12,5	04	203,2	17,7	64	263,0	23,0
25	24,9	02,2	85	84,7	07,4	45	144,4	12,6	05	204,2	17,8	65	264,0	23,1
26	25,9	02,3	86	85,7	07,5	46	145,4	12,7	06	205,2	17,9	66	265,0	23,1
27	26,9	02,4	87	86,7	07,6	47	146,4	12,8	07	206,2	18,0	67	266,0	23,2
28	27,9	02,4	88	87,7	07,7	48	147,4	12,9	08	207,2	18,1	68	267,0	23,3
29	28,9	02,5	89	88,7	07,8	49	148,4	13,0	09	208,2	18,2	69	268,0	23,4
30	29,9	02,6	90	89,7	07,8	50	149,4	13,1	10	209,2	18,3	70	269,0	23,5
31	30,9	02,7	91	90,7	07,9	151	150,4	13,1	211	210,2	18,4	271	270,0	23,6
32	31,9	02,8	92	91,6	08,0	52	151,4	13,2	12	211,2	18,4	72	271,0	23,7
33	32,9	02,9	93	92,6	08,1	53	152,4	13,3	13	212,2	18,5	73	272,0	23,8
34	33,9	03,0	94	93,6	08,2	54	153,4	13,4	14	213,2	18,6	74	273,0	23,8
35	34,9	03,1	95	94,6	08,3	55	154,4	13,5	15	214,2	18,7	75	274,0	23,9
36	35,9	03,1	96	95,6	08,4	56	155,4	13,6	16	215,2	18,8	76	275,0	24,0
37	36,9	03,2	97	96,6	08,5	57	156,4	13,7	17	216,2	18,9	77	275,9	24,1
38	37,9	03,3	98	97,6	08,5	58	157,4	13,7	18	217,2	19,0	78	276,9	24,2
39	38,9	03,4	99	98,6	08,6	59	158,4	13,8	19	218,2	19,1	79	277,9	24,3
40	39,8	03,5	100	99,6	08,7	60	159,4	13,9	20	219,2	19,1	80	278,9	24,4
41	40,8	03,6	101	100,6	08,8	161	160,4	14,0	221	220,2	19,2	281	279,9	24,4
42	41,8	03,7	02	101,6	08,9	62	161,4	14,1	22	221,2	19,3	82	280,9	24,5
43	42,8	03,8	03	102,6	09,0	63	162,4	14,2	23	222,2	19,4	83	281,9	24,6
44	43,8	03,8	04	103,6	09,0	64	163,4	14,3	24	223,1	19,5	84	282,9	24,7
45	44,8	03,9	05	104,6	09,1	65	164,4	14,4	25	224,1	19,6	85	283,9	24,8
46	45,8	04,0	06	105,6	09,2	66	165,4	14,4	26	225,1	19,7	86	284,9	24,9
47	46,8	04,1	07	106,6	09,3	67	166,4	14,5	27	226,1	19,7	87	285,9	25,0
48	47,8	04,2	08	107,6	09,4	68	167,4	14,6	28	227,1	19,8	88	286,9	25,1
49	48,8	04,3	09	108,6	09,5	69	168,4	14,7	29	228,1	19,9	89	287,9	25,1
50	49,8	04,4	10	109,6	09,6	70	169,4	14,8	30	229,1	20,0	90	288,9	25,2
51	50,8	04,4	111	110,6	09,7	171	170,4	14,9	231	230,1	20,1	291	289,9	25,3
52	51,8	04,5	12	111,6	09,7	72	171,3	15,0	32	231,1	20,2	92	290,9	25,4
53	52,8	04,6	13	112,6	09,8	73	172,3	15,1	33	232,1	20,3	93	291,9	25,5
54	53,8	04,7	14	113,6	09,9	74	173,3	15,1	34	233,1	20,4	94	292,9	25,6
55	54,8	04,8	15	114,6	10,0	75	174,3	15,2	35	234,1	20,4	95	293,9	25,7
56	55,8	04,9	16	115,6	10,1	76	175,3	15,3	36	235,1	20,5	96	294,9	25,8
57	56,8	05,0	17	116,6	10,2	77	176,3	15,4	27	236,1	20,6	97	295,9	25,8
58	57,8	05,1	18	117,6	10,3	78	177,3	15,5	38	237,1	20,7	98	296,9	25,9
59	58,8	05,1	19	118,5	10,4	79	178,3	15,6	39	238,1	20,8	99	297,9	26,0
60	59,8	05,2	20	119,5	10,4	80	179,3	15,7	40	239,1	20,9	300	298,9	26,1
D. ft.	Dep.	Lat.	D. ft.	Dep.	Lat.	D. ft.	Dep.	Lat.	D. ft.	Dep.	Lat.	D. ft.	Dep.	Lat.

for 85 Deg.

Difference of Latitude and Departure for 6 Deg.

Dist.	Lat.	Dep.	D. ft.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01,0	00,1	61	60,7	06,4	121	120,3	12,6	181	180,0	18,9	241	239,7	25,2
2	02,0	00,2	62	61,7	06,5	22	121,3	12,7	82	181,0	19,0	42	240,7	25,3
3	03,0	00,3	63	62,7	06,6	23	122,3	12,9	83	182,0	19,1	43	241,7	25,4
4	04,0	00,4	64	63,6	06,7	24	123,3	13,0	84	183,0	19,2	44	242,7	25,5
5	05,0	00,5	65	64,6	06,8	25	124,3	13,1	85	184,0	19,3	45	243,7	25,6
6	06,0	00,6	66	65,6	06,9	26	125,3	13,2	86	185,0	19,4	46	244,6	25,7
7	07,0	00,7	67	66,6	07,0	27	126,3	13,3	87	186,0	19,5	47	245,6	25,8
8	08,0	00,8	68	67,6	07,1	28	127,3	13,4	88	187,0	19,6	48	246,6	25,9
9	08,9	00,9	69	68,6	07,2	29	128,3	13,5	89	188,0	19,8	49	247,6	26,0
10	09,9	01,0	70	69,6	07,3	30	129,3	13,6	90	189,0	19,9	50	248,6	26,1
11	10,9	01,1	71	70,6	07,4	131	130,3	13,7	191	189,9	20,0	251	249,6	26,2
12	11,9	01,3	72	71,6	07,5	32	131,3	13,8	92	190,9	20,1	52	250,6	26,3
13	12,9	01,4	73	72,6	07,6	33	132,3	13,9	93	191,9	20,2	53	251,6	26,4
14	13,9	01,5	74	73,6	07,7	34	133,3	14,0	94	192,9	20,3	54	252,6	26,5
15	14,9	01,6	75	74,6	07,8	35	134,3	14,1	95	193,9	20,4	55	253,6	26,6
16	15,9	01,7	76	75,6	07,9	36	135,3	14,2	96	194,9	20,5	56	254,6	26,8
17	16,9	01,8	77	76,6	08,0	37	136,2	14,3	97	195,9	20,6	57	255,6	26,9
18	17,9	01,9	78	77,6	08,1	38	137,2	14,4	98	196,9	20,7	58	256,6	27,0
19	18,9	02,0	79	78,6	08,3	39	138,2	14,5	99	197,9	20,8	59	257,6	27,2
20	19,9	02,1	80	79,6	08,4	40	139,2	14,6	200	198,9	20,9	60	258,6	27,2
21	20,9	02,2	81	80,6	08,5	141	140,2	14,7	201	199,9	21,0	261	259,6	27,3
22	21,9	02,3	82	81,5	08,6	42	141,2	14,8	02	200,9	21,1	62	260,6	27,4
23	22,9	02,4	83	82,5	08,7	43	142,2	14,9	03	201,9	21,2	63	261,6	27,5
24	23,9	02,5	84	83,5	08,8	44	143,2	15,0	04	202,9	21,3	64	262,5	27,6
25	24,9	02,6	85	84,5	08,9	45	144,2	15,2	05	203,9	21,4	65	263,5	27,7
26	25,9	02,7	86	85,5	09,0	46	145,2	15,3	06	204,9	21,5	66	264,5	27,8
27	26,9	02,8	87	86,5	09,1	47	146,2	15,4	07	205,9	21,6	67	265,5	27,9
28	27,8	02,9	88	87,5	09,2	48	147,2	15,5	08	206,9	21,7	68	266,5	28,0
29	28,8	03,0	89	88,5	09,3	49	148,2	15,6	09	207,9	21,8	69	267,5	28,1
30	29,8	03,1	90	89,5	09,4	50	149,2	15,7	10	208,8	21,9	70	268,5	28,2
31	30,8	03,2	91	90,5	09,5	151	150,2	15,8	211	209,8	22,0	271	269,5	28,3
32	31,8	03,3	92	91,5	09,6	52	151,2	15,9	12	210,8	22,2	72	270,5	28,4
33	32,8	03,4	93	92,5	09,7	53	152,2	16,0	13	211,8	22,3	73	271,5	28,5
34	33,8	03,6	94	93,5	09,8	54	153,2	16,1	14	212,8	22,4	74	272,5	28,6
35	34,8	03,7	95	94,5	09,9	55	154,1	16,2	15	213,8	22,5	75	273,5	28,7
36	35,8	03,8	96	95,5	10,0	56	155,1	16,3	16	214,8	22,6	76	274,5	28,8
37	36,8	03,9	97	96,5	10,1	57	156,1	16,4	17	215,8	22,7	77	275,5	28,9
38	37,8	04,0	98	97,5	10,2	58	157,1	16,5	18	216,8	22,8	78	276,5	29,1
39	38,8	04,1	99	98,5	10,3	59	158,1	16,6	19	217,8	22,9	79	277,5	29,2
40	39,8	04,2	100	99,5	10,5	60	159,1	16,7	20	218,8	23,0	80	278,5	29,3
41	40,8	04,3	101	100,4	10,6	161	160,1	16,8	221	219,8	23,1	281	279,5	29,4
42	41,8	04,4	02	101,4	10,7	62	161,1	16,9	22	220,8	23,2	82	280,4	29,5
43	42,8	04,5	03	102,4	10,8	63	162,1	17,0	23	221,8	23,3	83	281,4	29,6
44	43,8	04,6	04	103,4	10,9	64	163,1	17,1	24	222,8	23,4	84	282,4	29,7
45	44,8	04,7	05	104,4	11,0	65	164,1	17,2	25	223,8	23,5	85	283,4	29,8
46	45,7	04,8	06	105,4	11,1	66	165,1	17,3	26	224,8	23,6	86	284,4	29,9
47	46,7	04,9	07	106,4	11,2	67	166,1	17,5	27	225,8	23,7	87	285,4	30,0
48	47,7	05,0	08	107,4	11,3	68	167,1	17,6	28	226,7	23,8	88	286,4	30,1
49	48,7	05,1	09	108,4	11,4	69	168,1	17,7	29	227,7	23,9	89	287,4	30,2
50	49,7	05,2	10	109,4	11,5	70	169,1	17,8	30	228,7	24,0	90	288,4	30,3
51	50,7	05,3	111	110,4	11,6	171	170,1	17,9	231	229,7	24,1	291	289,4	30,4
52	51,7	05,4	12	111,4	11,7	72	171,1	18,0	32	230,7	24,2	92	290,4	30,5
53	52,7	05,5	13	112,4	11,8	73	172,0	18,1	33	231,7	24,3	93	291,4	30,6
54	53,7	05,6	14	113,4	11,9	74	173,0	18,2	34	232,7	24,5	94	292,4	30,7
55	54,7	05,7	15	114,4	12,0	75	174,0	18,3	35	233,7	24,6	95	293,4	30,8
56	55,7	05,9	16	115,4	12,1	76	175,0	18,4	36	234,7	24,7	96	294,4	30,9
57	56,7	06,0	17	116,4	12,2	77	176,0	18,5	37	235,7	24,8	97	295,4	31,0
58	57,7	06,1	18	117,4	12,3	78	177,0	18,6	38	236,7	24,9	98	296,4	31,1
59	58,7	06,2	19	118,4	12,4	79	178,0	18,7	39	237,7	25,0	99	297,4	31,2
60	59,7	06,3	20	119,4	12,5	80	179,0	18,8	40	238,7	25,1	100	298,4	31,4
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 84 Deg.

Difference of Latitude and Departure for 7 Deg.

Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.
1	01,0	00,1	61	60,5	07,4	121	120,1	14,7	181	179,6	22,0	241	239,2	29,3			
2	02,0	00,2	62	61,5	07,5	22	121,1	14,9	82	180,6	22,2	42	240,2	29,5			
3	03,0	00,4	63	62,5	07,7	23	122,1	15,0	83	181,6	22,3	43	241,2	29,6			
4	04,0	00,5	64	63,5	07,8	24	123,1	15,1	84	182,6	22,4	44	242,2	29,7			
5	05,0	00,6	65	64,5	07,9	25	124,1	15,2	85	183,6	22,5	45	243,2	29,8			
6	06,0	00,7	66	65,5	08,0	26	125,1	15,3	86	184,6	22,7	46	244,1	29,9			
7	06,9	00,9	67	66,5	08,2	27	126,0	15,5	87	185,6	22,8	47	245,1	30,1			
8	07,9	01,0	68	67,5	08,3	28	127,0	15,6	88	186,6	22,9	48	246,1	30,2			
9	08,9	01,1	69	68,5	08,4	29	128,0	15,7	89	187,6	23,0	49	247,1	30,3			
10	09,9	01,2	70	69,5	08,5	30	129,0	15,8	90	188,6	23,1	50	248,1	30,4			
11	10,9	01,3	71	70,5	08,6	131	130,0	16,0	191	189,6	23,3	251	249,1	30,6			
12	11,9	01,5	72	71,5	08,8	32	131,0	16,1	92	190,6	23,4	52	250,1	30,7			
13	12,9	01,6	73	72,5	08,9	33	132,0	16,2	93	191,6	23,5	53	251,1	30,8			
14	13,9	01,7	74	73,4	09,0	34	133,0	16,3	94	192,5	23,6	54	252,1	30,9			
15	14,9	01,8	75	74,4	09,1	35	134,0	16,4	95	193,5	23,7	55	253,1	31,0			
16	15,9	01,9	76	75,4	09,3	36	135,0	16,6	96	194,5	23,9	56	254,1	31,2			
17	16,9	02,1	77	76,4	09,4	37	136,0	16,7	97	195,5	24,0	57	255,1	31,3			
18	17,9	02,2	78	77,4	09,5	38	137,0	16,8	98	196,5	24,1	58	256,1	31,4			
19	18,9	02,3	79	78,4	09,6	39	138,0	16,9	99	197,5	24,2	59	257,1	31,5			
20	19,9	02,4	80	79,4	09,7	40	139,0	17,1	200	198,5	24,3	60	258,1	31,7			
21	20,8	02,6	81	80,4	09,9	141	139,9	17,2	201	199,5	24,5	261	259,0	31,8			
22	21,8	02,7	82	81,4	10,0	42	140,9	17,3	02	200,5	24,6	62	260,0	31,9			
23	22,8	02,8	83	82,4	10,1	43	141,9	17,4	03	201,5	24,7	63	261,0	32,0			
24	23,8	02,9	84	83,4	10,2	44	142,9	17,5	04	202,5	24,8	64	262,0	32,1			
25	24,8	03,0	85	84,4	10,4	45	143,9	17,7	05	203,5	25,0	65	263,0	32,3			
26	25,8	03,2	86	85,4	10,5	46	144,9	17,8	06	204,5	25,1	66	264,0	32,4			
27	26,8	03,3	87	86,3	10,6	47	145,9	17,9	07	205,4	25,2	67	265,0	32,5			
28	27,8	03,4	88	87,3	10,7	48	146,9	18,0	08	206,4	25,3	68	266,0	32,6			
29	28,8	03,5	89	88,3	10,8	49	147,9	18,1	09	207,4	25,4	69	267,0	32,8			
30	29,8	03,7	90	89,1	11,0	50	148,9	18,3	10	208,4	25,6	70	268,0	32,9			
31	30,8	03,8	91	90,3	11,1	151	149,9	18,4	211	209,4	25,7	271	269,0	33,0			
32	31,8	03,9	92	91,3	11,2	52	150,9	18,5	12	210,4	25,8	72	270,0	33,1			
33	32,8	04,0	93	92,3	11,3	53	151,9	18,6	13	211,4	25,9	73	271,0	33,2			
34	33,7	04,1	94	93,3	11,5	54	152,8	18,7	14	212,4	26,1	74	271,9	33,4			
35	34,7	04,3	95	94,3	11,6	55	153,8	18,9	15	213,4	26,2	75	272,9	33,5			
36	35,7	04,4	96	95,3	11,7	56	154,8	19,0	16	214,4	26,3	76	273,9	33,6			
37	36,7	04,5	97	96,3	11,8	57	155,8	19,1	17	215,4	26,4	77	274,9	33,7			
38	37,7	04,6	98	97,3	11,9	58	156,8	19,2	18	216,4	26,5	78	275,9	33,9			
39	38,7	04,8	99	98,3	12,1	59	157,8	19,4	19	217,4	26,7	79	276,9	34,0			
40	39,7	04,9	100	99,3	12,2	60	158,8	19,5	20	218,4	26,8	80	277,9	34,1			
41	40,7	05,0	101	100,2	12,3	161	159,8	19,6	221	219,3	26,9	281	278,9	34,2			
42	41,7	05,1	02	101,2	12,4	62	160,8	19,7	22	220,3	27,0	82	279,9	34,3			
43	42,7	05,2	03	102,2	12,5	63	161,8	19,8	23	221,3	27,2	83	280,9	34,5			
44	43,7	05,4	04	103,2	12,7	64	162,8	20,0	24	222,3	27,3	84	281,9	34,6			
45	44,7	05,5	05	104,2	12,8	65	163,8	20,1	25	223,3	27,4	85	282,9	34,7			
46	45,7	05,6	06	105,2	12,9	66	164,8	20,2	26	224,3	27,5	86	283,9	34,8			
47	46,6	05,7	07	106,2	13,0	67	165,7	20,3	27	225,3	27,6	87	284,8	34,9			
48	47,6	05,8	08	107,2	13,1	68	166,7	20,5	28	226,3	27,8	88	285,8	35,1			
49	48,6	06,0	09	108,2	13,3	69	167,7	20,6	29	227,3	27,9	89	286,8	35,2			
50	49,6	06,1	10	109,2	13,4	70	168,7	20,7	30	228,3	28,0	90	287,8	35,3			
51	50,6	06,2	111	110,2	13,5	171	169,7	20,8	231	229,3	28,1	291	288,8	35,4			
52	51,6	06,3	12	111,2	13,6	72	170,7	20,9	32	230,3	28,3	92	289,8	35,5			
53	52,6	06,5	13	112,2	13,8	73	171,7	21,1	33	231,3	28,4	93	290,8	35,7			
54	53,6	06,6	14	113,1	13,9	74	172,7	21,2	34	232,2	28,5	94	291,8	35,8			
55	54,6	06,7	15	114,1	14,0	75	173,7	21,3	35	233,2	28,6	95	292,8	35,9			
56	55,6	06,8	16	115,1	14,1	76	174,7	21,4	36	234,2	28,7	96	293,8	36,0			
57	56,6	06,9	17	116,1	14,2	77	175,7	21,6	37	235,2	28,9	97	294,8	36,2			
58	57,6	07,1	18	117,1	14,4	78	176,7	21,7	38	236,2	29,0	98	295,8	36,3			
59	58,6	07,2	19	118,1	14,5	79	177,7	21,8	39	237,2	29,1	99	296,8	36,4			
60	59,6	07,3	20	119,1	14,6	80	178,7	21,9	40	238,2	29,2	300	297,8	36,5			
Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.

Difference of Latitude and Departure for 8 Deg.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01,0	00,1	61	60,4	8,5	121	119,8	16,8	181	179,2	25,2	241	238,7	33,5	301	286,2	41,8
2	02,0	00,3	62	61,4	08,6	22	120,8	17,1	82	180,2	25,3	42	239,7	33,7	92	287,2	42,0
3	03,0	00,4	63	62,4	08,8	23	121,8	17,3	83	181,2	25,5	43	240,6	33,8	93	288,2	42,2
4	04,0	00,6	64	63,4	08,9	24	122,8	17,5	84	182,2	25,6	44	241,6	34,0	94	289,2	42,4
5	05,0	00,7	65	64,4	09,0	25	123,8	17,7	85	183,2	25,8	45	242,6	34,1	95	290,2	42,6
6	05,9	00,8	66	65,4	09,2	26	124,8	17,9	86	184,2	25,9	46	243,6	34,2	96	291,2	42,8
7	06,9	01,0	67	66,4	09,3	27	125,8	17,7	87	185,2	26,0	47	244,6	34,4	97	292,2	43,0
8	07,9	01,1	68	67,3	09,5	28	126,8	17,8	88	186,2	26,2	48	245,6	34,5	98	293,2	43,2
9	08,9	01,3	69	68,3	09,6	29	127,7	18,0	89	187,2	26,3	49	246,6	34,7	99	294,2	43,4
10	09,9	01,4	70	69,3	09,7	30	128,7	18,1	90	188,2	26,4	50	247,6	34,8	100	295,2	43,6
11	10,9	01,5	71	70,3	09,9	31	129,7	17,2	191	189,1	26,6	251	248,6	34,9	151	296,2	43,8
12	11,9	01,7	72	71,3	10,0	32	130,7	18,4	92	190,1	26,7	52	249,6	35,1	152	297,2	44,0
13	12,9	01,8	73	72,3	10,2	33	131,7	18,5	93	191,1	26,9	53	250,6	35,2	153	298,2	44,2
14	13,9	01,9	74	73,3	10,3	34	132,7	18,7	94	192,1	27,0	54	251,6	35,4	154	299,2	44,4
15	14,9	02,1	75	74,3	10,4	35	133,7	18,8	95	193,1	27,1	55	252,6	35,5	155	300,2	44,6
16	15,8	02,2	76	75,3	10,6	36	134,7	18,9	96	194,1	27,3	56	253,6	35,6	156	301,2	44,8
17	16,8	02,4	77	76,3	10,7	37	135,7	19,1	97	195,1	27,4	57	254,6	35,8	157	302,2	45,0
18	17,8	02,5	78	77,2	10,9	38	136,7	19,2	98	196,1	27,6	58	255,6	35,9	158	303,2	45,2
19	18,8	02,6	79	78,2	11,0	39	137,7	19,3	99	197,1	27,7	59	256,6	36,1	159	304,2	45,4
20	19,8	02,8	80	79,2	11,1	40	138,6	19,5	200	198,1	27,8	60	257,6	36,2	160	305,2	45,6
21	20,8	02,9	81	80,2	11,3	141	139,6	19,6	201	199,9	28,0	261	258,6	36,3	161	306,2	45,8
22	21,8	03,1	82	81,2	11,4	42	140,6	19,8	02	200,0	28,1	62	259,6	36,5	162	307,2	46,0
23	22,8	03,2	83	82,2	11,6	43	141,6	19,9	03	201,0	28,3	63	260,6	36,6	163	308,2	46,2
24	23,8	03,3	84	83,2	11,7	44	142,6	20,0	04	202,0	28,4	64	261,6	36,7	164	309,2	46,4
25	24,8	03,5	85	84,2	11,8	45	143,6	20,2	05	203,0	28,5	65	262,6	36,9	165	310,2	46,6
26	25,7	03,6	86	85,2	12,0	46	144,6	20,3	06	204,0	28,7	66	263,6	37,0	166	311,2	46,8
27	26,7	03,8	87	86,2	12,1	47	145,6	20,5	07	205,0	28,8	67	264,6	37,2	167	312,2	47,0
28	27,7	03,9	88	87,1	12,2	48	146,6	20,6	08	206,0	29,0	68	265,6	37,3	168	313,2	47,2
29	28,7	04,0	89	88,1	12,4	49	147,6	20,7	09	207,0	29,1	69	266,6	37,4	169	314,2	47,4
30	29,7	04,2	90	89,1	12,5	50	148,5	20,9	10	208,0	29,2	70	267,6	37,6	170	315,2	47,6
31	30,7	04,3	91	90,1	12,7	151	149,5	21,0	211	209,0	29,4	271	268,6	37,7	171	316,2	47,8
32	31,7	04,5	92	91,1	12,8	52	150,5	21,2	12	209,9	29,5	72	269,6	37,9	172	317,2	48,0
33	32,7	04,6	93	92,1	12,9	53	151,5	21,3	13	210,9	29,6	73	270,6	38,0	173	318,2	48,2
34	33,7	04,7	94	93,1	13,1	54	152,5	21,4	14	211,9	29,8	74	271,6	38,1	174	319,2	48,4
35	34,7	04,9	95	94,1	13,2	55	153,5	21,6	15	212,9	29,9	75	272,6	38,3	175	320,2	48,6
36	35,7	05,0	96	95,1	13,4	56	154,5	21,7	16	213,9	30,1	76	273,6	38,4	176	321,2	48,8
37	36,6	05,2	97	96,1	13,5	57	155,5	21,9	17	214,9	30,2	77	274,6	38,6	177	322,2	49,0
38	37,6	05,4	98	97,0	13,6	58	156,5	22,0	18	215,9	30,3	78	275,6	38,7	178	323,2	49,2
39	38,6	05,5	99	98,0	13,8	59	157,5	22,1	19	216,9	30,5	79	276,6	38,8	179	324,2	49,4
40	39,6	05,6	100	99,0	13,9	60	158,4	22,3	20	217,9	30,6	80	277,6	39,0	180	325,2	49,6
41	40,6	05,7	101	100,0	14,1	161	159,4	22,4	221	218,9	30,8	281	278,6	39,1	181	326,2	49,8
42	41,6	05,8	02	101,0	14,2	62	160,4	22,6	22	219,8	30,9	82	279,6	39,3	182	327,2	50,0
43	42,6	06,0	03	102,0	14,3	63	161,4	22,7	23	220,8	31,0	83	280,6	39,4	183	328,2	50,2
44	43,6	06,1	04	103,0	14,5	64	162,4	22,8	24	221,8	31,2	84	281,6	39,5	184	329,2	50,4
45	44,6	06,3	05	104,0	14,6	65	163,4	23,0	25	222,8	31,3	85	282,6	39,7	185	330,2	50,6
46	45,6	06,4	06	105,0	14,8	66	164,4	23,1	26	223,8	31,5	86	283,6	39,8	186	331,2	50,8
47	46,5	06,5	07	106,0	14,9	67	165,4	23,2	27	224,8	31,6	87	284,6	40,0	187	332,2	51,0
48	47,5	06,7	08	107,0	15,0	68	166,4	23,4	28	225,8	31,7	88	285,6	40,1	188	333,2	51,2
49	48,5	06,8	09	107,9	15,2	69	167,4	23,5	29	226,8	31,9	89	286,6	40,2	189	334,2	51,4
50	49,5	07,0	10	108,9	15,3	70	168,4	23,7	30	227,8	32,0	90	287,6	40,4	190	335,2	51,6
51	50,5	07,1	111	109,9	15,5	171	169,3	23,8	221	228,8	32,2	291	288,6	40,5	191	336,2	51,8
52	51,5	07,2	12	110,9	15,6	72	170,3	23,9	22	229,7	32,3	92	289,6	40,6	192	337,2	52,0
53	52,5	07,4	13	111,0	15,7	73	171,3	24,1	33	230,7	32,4	93	290,6	40,8	193	338,2	52,2
54	53,5	07,5	14	112,9	15,9	74	172,3	24,2	34	231,7	32,6	94	291,6	40,9	194	339,2	52,4
55	54,5	07,7	15	113,9	16,0	75	173,3	24,4	35	232,7	32,7	95	292,6	41,1	195	340,2	52,6
56	55,5	07,8	16	114,9	16,1	76	174,3	24,5	36	233,7	32,9	96	293,6	41,2	196	341,2	52,8
57	56,4	07,9	17	115,9	16,3	77	175,3	24,6	37	234,7	33,0	97	294,6	41,3	197	342,2	53,0
58	57,4	08,1	18	116,9	16,4	78	176,3	24,8	38	235,7	33,1	98	295,6	41,5	198	343,2	53,2
59	58,4	08,2	19	117,8	16,6	79	177,3	24,9	39	236,7	33,3	99	296,6	41,6	199	344,2	53,4
60	59,4	08,4	20	118,8	16,7	80	178,3	25,1	40	237,7	33,4	200	297,6	41,8	200	345,2	53,6
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

Difference of Latitude and Departure for 9 Deg.

Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.
1	01,0	00,1	61	60,2	09,5	121	119,5	18,9	181	178,8	28,3	241	238,0	37,7
2	02,0	00,3	62	61,2	09,7	22	120,5	19,1	82	179,8	28,5	42	239,0	37,8
3	03,0	00,5	63	62,2	09,9	23	121,5	19,2	83	180,7	28,6	43	240,0	38,0
4	04,0	00,6	64	63,2	10,0	24	122,5	19,4	84	181,7	28,8	44	241,0	38,2
5	04,9	00,8	65	64,2	10,2	25	123,5	19,6	85	182,7	28,9	45	242,0	38,3
6	05,9	00,9	66	65,2	10,3	26	124,5	19,7	86	183,7	29,1	46	243,0	38,5
7	06,9	01,1	67	66,2	10,5	27	125,4	19,9	87	184,7	29,2	47	244,0	38,6
8	07,9	01,3	68	67,2	10,6	28	126,4	20,0	88	185,7	29,4	48	244,9	38,8
9	08,9	01,4	69	68,2	10,8	29	127,4	20,2	89	186,7	29,6	49	245,9	38,9
10	09,9	01,6	70	69,1	10,9	30	128,4	20,3	90	187,7	29,7	50	246,9	39,1
11	10,9	01,7	71	70,1	11,1	131	129,4	20,5	191	188,7	29,9	251	247,9	39,3
12	11,9	01,9	72	71,1	11,3	32	130,4	20,6	92	189,6	30,0	52	248,9	39,4
13	12,9	02,0	73	72,1	11,4	33	131,4	20,8	93	190,6	30,2	53	249,9	39,6
14	13,8	02,2	74	73,1	11,6	34	132,4	21,0	94	191,6	30,3	54	250,9	39,7
15	14,8	02,3	75	74,1	11,7	35	133,3	21,1	95	192,6	30,5	55	251,9	39,9
16	15,8	02,5	76	75,1	11,9	36	134,3	21,3	96	193,6	30,7	56	252,9	40,0
17	16,8	02,7	77	76,1	12,0	37	135,3	21,4	97	194,6	30,8	57	253,8	40,2
18	17,8	02,8	78	77,0	12,2	38	136,3	21,6	98	195,6	31,0	58	254,8	40,4
19	18,8	03,0	79	78,0	12,4	39	137,3	21,7	99	196,6	31,1	59	255,8	40,5
20	19,8	03,1	80	79,0	12,5	40	138,3	21,9	200	197,5	31,3	60	256,8	40,7
21	20,7	03,3	81	80,0	12,7	141	139,3	22,1	201	198,5	31,4	261	257,8	40,8
22	21,7	03,4	82	81,0	12,8	42	140,3	22,2	02	199,5	31,6	62	258,8	41,0
23	22,7	03,6	83	82,0	13,0	43	141,2	22,4	03	200,5	31,7	63	259,8	41,1
24	23,7	03,8	84	83,0	13,1	44	142,2	22,5	04	201,5	31,9	64	260,8	41,3
25	24,7	03,9	85	84,0	13,3	45	143,2	22,7	05	202,5	32,1	65	261,7	41,4
26	25,7	04,1	86	84,9	13,5	46	144,2	22,8	06	203,5	32,2	66	262,7	41,6
27	26,7	04,2	87	85,9	13,6	47	145,2	23,0	07	204,5	32,4	67	263,7	41,8
28	27,7	04,4	88	86,9	13,8	48	146,2	23,1	08	205,4	32,5	68	264,7	41,9
29	28,6	04,5	89	87,9	13,9	49	147,2	23,3	09	206,4	32,7	69	265,7	42,1
30	29,6	04,7	90	88,9	14,1	50	148,2	23,5	10	207,4	32,8	70	266,7	42,2
31	30,6	04,8	91	89,9	14,2	151	149,1	23,6	211	208,4	33,0	271	267,7	42,4
32	31,6	05,0	92	90,9	14,4	52	150,1	23,8	12	209,4	33,2	72	268,7	42,5
33	32,6	05,2	93	91,9	14,5	53	151,1	23,9	13	210,4	33,3	73	269,6	42,7
33	33,6	05,3	94	92,8	14,7	54	152,1	24,1	14	211,4	33,5	74	270,6	42,9
35	34,6	05,5	95	93,8	14,9	55	153,1	24,2	15	212,4	33,6	75	271,6	43,0
36	35,6	05,6	96	94,8	15,0	56	154,1	24,4	16	213,3	33,8	76	272,6	43,2
37	36,5	05,8	97	95,8	15,2	57	155,1	24,6	17	214,3	33,9	77	273,6	43,3
38	37,5	05,9	98	96,8	15,3	58	156,1	24,7	18	215,3	34,1	78	274,6	43,5
39	38,5	06,1	99	97,8	15,5	59	157,0	24,9	19	216,3	34,3	79	275,6	43,6
40	39,5	06,3	100	98,8	15,6	60	158,0	25,0	20	217,3	34,4	80	276,6	43,8
41	40,5	06,4	101	99,8	15,8	161	159,0	25,2	221	218,3	34,6	281	277,5	43,9
42	41,5	06,6	02	100,7	16,0	62	160,0	25,3	22	219,3	34,7	82	278,5	44,1
43	42,5	06,7	03	101,7	16,1	63	161,0	25,5	23	220,3	34,9	83	279,5	44,3
44	43,5	06,9	04	102,7	16,3	64	162,0	25,6	24	221,2	35,0	84	280,5	44,4
45	44,4	07,0	05	103,7	16,4	65	163,0	25,8	25	222,2	35,2	85	281,5	44,6
46	45,4	07,2	06	104,7	16,6	66	164,0	26,0	26	223,2	35,3	86	282,5	44,7
47	46,4	07,4	07	105,7	16,7	67	164,9	26,1	27	224,2	35,5	87	283,5	44,9
48	47,4	07,5	08	106,7	16,9	68	165,9	26,3	28	225,2	35,7	88	284,5	45,0
49	48,4	07,7	09	107,7	17,0	69	166,9	26,4	29	226,2	35,8	89	285,4	45,2
50	49,4	07,8	10	108,6	17,2	70	167,9	26,6	30	227,2	36,0	290	286,4	45,4
51	50,4	08,0	111	109,6	17,4	171	168,9	26,7	231	228,2	36,1	291	287,4	45,5
52	51,4	08,1	12	110,6	17,5	72	169,9	26,9	32	229,1	36,3	92	288,4	45,7
53	52,3	08,3	13	111,6	17,7	73	170,9	27,1	33	230,1	36,4	93	289,4	45,8
54	53,3	08,4	14	112,6	17,8	74	171,9	27,2	34	231,1	36,6	94	290,4	46,0
55	54,3	08,6	15	113,6	18,0	75	172,8	27,4	35	232,1	36,8	95	291,4	46,1
56	55,3	08,8	16	114,6	18,1	76	173,8	27,5	36	233,1	36,9	96	292,4	46,3
57	56,3	08,9	17	115,6	18,3	77	174,8	27,7	37	234,1	37,1	97	293,3	46,5
58	57,3	09,1	18	116,5	18,5	78	175,8	27,8	38	235,1	37,2	98	294,3	46,6
59	58,3	09,2	19	117,5	18,6	79	176,8	28,0	39	236,1	37,4	99	295,3	46,8
60	59,3	09,4	20	118,5	18,8	80	177,8	28,2	40	237,0	37,5	300	296,3	46,9
Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.

[d]

for 81 Deg.

Difference of Latitude and Departure for 10 Deg.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01,0	00,2	61	60,1	10,6	121	119,2	21,0	181	178,2	31,4	241	237,3	41,8
2	02,0	00,3	62	61,1	10,8	22	120,1	21,2	82	179,2	31,6	42	238,3	42,0
3	03,0	00,5	63	62,0	10,9	23	121,1	21,3	83	180,2	31,7	43	239,3	42,1
4	03,9	00,7	64	63,0	11,1	24	122,1	21,5	84	181,2	31,9	44	240,3	42,3
5	04,9	00,9	65	64,0	11,2	25	123,1	21,7	85	182,2	32,1	45	241,3	42,5
6	05,9	01,0	66	65,0	11,4	26	124,1	21,8	86	183,2	32,3	46	242,3	42,7
7	06,9	01,2	67	66,0	11,6	27	125,1	22,0	87	184,2	32,4	47	243,2	42,8
8	07,9	01,4	68	67,0	11,8	28	126,1	22,2	88	185,1	32,6	48	244,2	43,0
9	08,9	01,6	69	68,0	12,0	29	127,0	22,4	89	186,1	32,8	49	245,2	43,2
10	09,8	01,7	70	68,9	12,1	30	128,0	22,5	90	187,1	32,9	50	246,2	43,4
11	10,8	01,9	71	69,9	12,3	131	129,0	22,7	191	188,1	33,1	251	247,2	43,5
12	11,8	02,1	72	70,9	12,5	32	130,0	22,9	92	189,1	33,3	52	248,2	43,7
13	12,8	02,3	73	71,9	12,7	33	131,0	23,1	93	190,1	33,5	53	249,2	43,9
14	13,8	02,4	74	72,9	12,8	34	132,0	23,2	94	191,0	33,6	54	250,1	44,0
15	14,8	02,6	75	73,9	13,0	35	132,9	23,4	95	192,0	33,8	55	251,1	44,2
16	15,8	02,8	76	74,8	13,2	36	133,9	23,6	96	193,0	34,0	56	252,1	44,4
17	16,7	02,9	77	75,8	13,4	37	134,9	23,8	97	194,0	34,2	57	253,1	44,6
18	17,7	03,1	78	76,8	13,5	38	135,9	23,9	98	195,0	34,5	58	254,1	44,7
19	18,7	03,3	79	77,8	13,7	39	136,9	24,1	99	196,0	34,5	59	255,1	44,9
20	19,7	03,5	80	78,8	13,9	40	137,9	24,3	200	197,0	34,7	60	256,0	45,1
21	20,7	03,6	81	79,8	14,0	141	138,9	24,4	201	197,9	34,9	261	257,0	45,3
22	21,7	03,8	82	80,8	14,2	42	139,8	24,6	02	198,9	35,0	62	258,0	45,4
23	22,7	04,0	83	81,7	14,4	43	140,8	24,8	03	199,9	35,2	63	259,0	45,6
24	23,6	04,2	84	82,7	14,6	44	141,8	25,0	04	200,9	35,4	64	260,0	45,8
25	24,6	04,3	85	83,7	14,7	45	142,8	25,1	05	201,9	35,5	65	261,0	46,0
26	25,6	04,5	86	84,7	14,9	46	143,8	25,3	06	202,9	35,7	66	262,0	46,1
27	26,6	04,7	87	85,7	15,1	47	144,8	25,5	07	203,9	35,9	67	262,9	46,3
28	27,6	04,9	88	86,7	15,3	48	145,7	25,7	08	204,9	36,1	68	263,9	46,5
29	28,6	05,0	89	87,6	15,4	49	146,7	25,8	09	205,8	36,2	69	264,9	46,6
30	29,5	05,2	90	88,6	15,6	50	147,7	26,0	10	206,8	36,4	70	265,9	46,8
31	30,5	05,4	91	89,6	15,8	151	148,7	26,2	211	207,8	36,6	271	266,9	47,0
32	31,5	05,5	92	90,6	16,0	52	149,7	26,4	12	208,8	36,8	72	267,9	47,2
33	32,5	05,7	93	91,6	16,1	53	150,7	26,5	13	209,8	36,9	73	268,8	47,3
34	33,5	05,9	94	92,6	16,3	54	151,7	26,7	14	210,7	37,1	74	269,8	47,5
35	34,5	06,1	95	93,6	16,5	55	152,6	26,9	15	211,7	37,3	75	270,8	47,7
36	35,5	06,2	96	94,5	16,6	56	153,6	27,1	16	212,7	37,5	76	271,8	47,9
37	36,4	06,4	97	95,5	16,8	57	154,6	27,2	17	213,7	37,6	77	272,8	48,0
38	37,4	06,6	98	96,5	17,0	58	155,6	27,4	18	214,7	37,8	78	273,8	48,2
39	38,4	06,8	99	97,5	17,2	59	156,6	27,6	19	215,7	38,0	79	274,8	48,4
40	39,4	06,9	100	98,5	17,3	60	157,6	27,7	20	216,7	38,1	80	275,7	48,6
41	40,4	07,1	101	99,5	17,5	161	158,6	27,9	221	217,6	38,3	281	276,7	48,7
42	41,4	07,3	02	100,4	17,7	62	159,5	28,1	22	218,6	38,5	82	277,7	48,9
43	42,3	07,5	03	101,4	17,9	63	160,5	28,3	23	219,6	38,7	83	278,7	49,1
44	43,3	07,6	04	102,4	18,0	64	161,5	28,4	24	220,6	38,8	84	279,7	49,2
45	44,3	07,8	05	103,4	18,2	65	162,5	28,6	25	221,6	39,0	85	280,7	49,4
46	45,3	08,0	06	104,4	18,4	66	163,5	28,8	26	222,6	39,2	86	281,6	49,6
47	46,3	08,1	07	105,4	18,6	67	164,5	29,0	27	223,5	39,4	87	282,6	49,8
48	47,3	08,3	08	106,4	18,7	68	165,4	29,1	28	224,5	39,5	88	283,6	49,9
49	48,3	08,5	09	107,3	18,9	69	166,4	29,3	29	225,5	39,7	89	284,6	50,1
50	49,2	08,7	10	108,3	19,1	70	167,4	29,5	30	226,5	39,9	90	285,6	50,3
51	50,2	08,8	111	109,3	19,2	171	168,4	29,7	231	227,5	40,1	291	286,6	50,5
52	51,2	09,0	12	110,3	19,4	72	169,4	29,8	32	228,5	40,2	92	287,6	50,6
53	52,2	09,2	13	111,3	19,6	73	170,4	30,0	33	229,5	40,4	93	288,5	50,8
54	53,2	09,4	14	112,3	19,8	74	171,4	30,2	34	230,4	40,6	94	289,5	51,0
55	54,2	09,5	15	113,3	19,9	75	172,3	30,3	35	231,4	40,7	95	290,5	51,2
56	55,1	09,7	16	114,2	20,1	76	173,3	30,5	36	232,4	40,9	96	291,5	51,3
57	56,1	09,9	17	115,2	20,3	77	174,3	30,7	37	233,4	41,1	97	292,5	51,5
58	57,1	10,1	18	116,2	20,5	78	175,3	30,9	38	234,4	41,3	98	293,5	51,7
59	58,1	10,2	19	117,2	20,6	79	176,3	31,0	39	235,4	41,4	99	294,5	51,8
60	59,1	10,4	20	118,2	20,8	80	177,3	31,2	40	236,3	41,6	300	295,4	52,0
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 30 Deg.

Difference of Latitude and Departure for 11 Deg.

Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.
1	01,0	00,2	61	59,9	11,6	121	118,8	23,1	181	177,7	34,5	241	236,6	46,0			
2	02,0	00,4	62	60,9	11,8	22	119,8	23,3	82	178,6	34,7	42	237,5	46,2			
3	03,9	00,6	63	61,8	12,0	23	120,7	23,5	83	179,6	34,9	43	238,5	46,4			
4	03,9	00,8	64	62,8	12,2	24	121,7	23,7	84	180,6	35,1	44	239,5	46,6			
5	04,9	01,0	65	63,8	12,4	25	122,7	23,9	85	181,6	35,3	45	240,5	46,7			
6	05,9	01,1	66	64,8	12,6	26	123,7	24,0	86	182,6	35,5	46	241,5	47,0			
7	06,9	01,3	67	65,8	12,8	27	124,7	24,2	87	183,6	35,7	47	242,5	47,1			
8	07,9	01,5	68	66,7	13,0	28	125,6	24,4	88	184,5	35,9	48	243,4	47,3			
9	08,8	01,7	69	67,7	13,2	29	126,6	24,6	89	185,5	36,1	49	244,4	47,5			
10	09,8	01,9	70	68,7	13,4	30	127,6	24,8	90	186,5	36,3	50	245,4	47,7			
11	10,8	02,1	71	69,7	13,5	31	128,6	25,0	191	187,5	36,4	251	246,4	47,9			
12	11,8	02,3	72	70,7	13,7	32	129,6	25,2	92	188,5	36,6	52	247,4	48,1			
13	12,8	02,5	73	71,7	13,9	33	130,6	25,4	93	189,4	36,8	53	248,3	48,3			
14	13,7	02,7	74	72,6	14,1	34	131,5	25,6	94	190,4	37,0	54	249,3	48,5			
15	14,7	02,9	75	73,6	14,3	35	132,5	25,8	95	191,4	37,2	55	250,3	48,7			
16	15,7	03,1	76	74,6	14,5	36	133,5	25,9	96	192,4	37,4	56	251,3	48,8			
17	16,7	03,2	77	75,6	14,7	37	134,5	26,1	97	193,4	37,6	57	252,3	49,0			
18	17,7	03,4	78	76,6	14,9	38	135,5	26,3	98	194,4	37,8	58	253,2	49,2			
19	18,7	03,6	79	77,5	15,1	39	136,4	26,5	99	195,4	38,0	59	254,2	49,4			
20	19,6	03,8	80	78,5	15,3	40	137,4	26,7	200	196,3	38,2	60	255,2	49,6			
21	20,6	04,0	81	79,5	15,5	141	138,4	26,9	201	197,3	38,4	261	256,2	49,8			
22	21,6	04,2	82	80,5	15,6	42	139,4	27,1	02	198,3	38,5	62	257,2	50,0			
23	22,6	04,4	83	81,5	15,8	43	140,4	27,3	03	199,3	38,7	63	258,2	50,2			
24	23,6	04,6	84	82,5	16,0	44	141,3	27,5	04	200,2	38,9	64	259,1	50,4			
25	24,5	04,8	85	83,4	16,2	45	142,3	27,7	05	201,2	39,1	65	260,1	50,6			
26	25,5	05,0	86	84,4	16,4	46	143,3	27,9	06	202,2	39,3	66	261,1	50,8			
27	26,5	05,2	87	85,4	16,6	47	144,3	28,0	07	203,2	39,5	67	262,1	50,9			
28	27,5	05,3	88	86,4	16,8	48	145,3	28,2	08	204,2	39,7	68	263,1	51,1			
29	28,5	05,5	89	87,4	17,0	49	146,3	28,4	09	205,2	39,9	69	264,0	51,3			
30	29,4	05,7	90	88,3	17,2	50	147,2	28,6	10	206,1	40,1	70	265,0	51,5			
31	30,4	05,9	91	89,3	17,4	151	148,2	28,8	211	207,1	40,3	271	266,0	51,7			
32	31,4	06,1	92	90,3	17,6	52	149,2	29,0	12	208,1	40,4	72	267,0	51,9			
33	32,4	06,3	93	91,3	17,7	53	150,2	29,2	13	209,1	40,6	73	268,0	52,1			
34	33,4	06,5	94	92,3	17,9	54	151,2	29,4	14	210,1	40,8	74	269,0	52,3			
35	34,4	06,7	95	93,3	18,1	55	152,1	29,6	15	211,0	41,0	75	269,9	52,5			
36	35,3	06,9	96	94,2	18,3	56	153,1	29,8	16	212,0	41,2	76	270,9	52,7			
37	36,3	07,1	97	95,2	18,5	57	154,1	30,0	17	213,0	41,4	77	271,9	52,9			
38	37,3	07,3	98	96,2	18,7	58	155,1	30,1	18	214,0	41,6	78	272,9	53,0			
39	38,3	07,4	99	97,2	18,9	59	156,1	30,3	19	215,0	41,8	79	273,9	53,2			
40	39,3	07,6	100	98,2	19,1	60	157,1	30,5	20	215,9	42,0	80	274,8	53,4			
41	40,2	07,8	101	99,1	19,3	161	158,0	30,7	221	216,9	42,2	281	275,8	53,6			
42	41,2	08,0	02	100,1	19,5	62	159,0	30,9	22	217,9	42,4	82	276,8	53,8			
43	42,2	08,2	03	101,1	19,7	63	160,0	31,1	23	218,9	42,5	83	277,8	54,0			
44	43,2	08,4	04	102,1	19,8	64	161,0	31,3	24	219,9	42,7	84	278,8	54,2			
45	44,2	08,6	05	103,1	20,0	65	162,0	31,5	25	220,9	42,9	85	279,8	54,4			
46	45,2	08,8	06	104,0	20,2	66	162,9	31,7	26	221,8	43,1	86	280,7	54,6			
47	46,1	09,0	07	105,0	20,4	67	163,9	31,9	27	222,8	43,3	87	281,7	54,8			
48	47,1	09,2	08	106,0	20,6	68	164,9	32,1	28	223,8	43,5	88	282,7	55,0			
49	48,1	09,3	09	107,0	20,8	69	165,9	32,2	29	224,8	43,7	89	283,7	55,1			
50	49,1	09,5	10	108,0	21,0	70	166,9	32,4	30	225,8	43,9	90	284,7	55,3			
51	50,1	09,7	111	109,0	21,2	171	167,9	32,6	231	226,7	44,1	291	285,6	55,5			
52	51,0	09,9	12	109,9	21,4	72	168,8	32,8	32	227,7	44,3	92	286,6	55,7			
53	52,0	10,1	13	110,9	21,6	73	169,8	33,0	33	228,7	44,5	93	287,6	55,9			
54	53,0	10,3	14	111,9	21,8	74	170,8	33,2	34	229,7	44,6	94	288,6	56,0			
55	54,0	10,5	15	112,9	21,9	75	171,8	33,4	35	230,7	44,8	95	289,6	56,3			
56	55,0	10,7	16	113,9	22,1	76	172,8	33,6	36	231,7	45,0	96	290,5	56,5			
57	56,0	10,9	17	114,8	22,3	77	173,7	33,8	37	232,6	45,2	97	291,5	56,7			
58	56,9	11,1	18	115,8	22,0	78	174,7	34,0	38	233,6	45,4	98	292,5	56,9			
59	57,9	11,3	19	116,8	22,7	79	175,7	34,2	39	234,6	45,6	99	293,5	57,0			
60	58,9	11,4	20	117,8	22,9	80	176,7	34,3	40	235,6	45,8	300	294,5	57,2			
Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.

Difference of Latitude and Departure for 12 Deg.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01,0	00,2	61	59,7	12,7	121	118,3	25,2	181	177,0	7,6	241	235,7	50,1
2	02,0	00,4	62	60,6	12,9	22	119,5	25,4	82	178,0	37,9	42	226,7	0,3
3	02,9	00,6	63	61,6	13,1	23	120,3	25,6	83	179,0	38,1	43	227,7	50,5
4	03,9	00,8	64	62,6	13,3	24	121,3	25,8	84	180,0	38,3	44	228,6	5,8
5	04,9	01,0	65	63,6	13,5	25	122,3	26,0	85	180,9	38,5	45	229,6	51,0
6	05,9	01,2	66	64,5	13,7	26	123,2	26,2	86	181,9	38,7	46	230,6	51,2
7	06,8	01,5	67	65,5	13,9	27	124,2	26,4	87	182,9	38,9	47	231,6	51,4
8	07,8	01,7	68	66,5	14,1	28	125,2	26,6	88	183,9	39,1	48	232,5	1,6
9	08,8	01,9	69	67,5	14,4	29	126,2	26,8	89	184,8	39,3	49	233,5	51,8
10	09,8	02,1	70	68,5	14,6	30	127,1	27,0	90	185,8	39,5	50	234,5	2,0
11	10,8	02,3	71	69,4	14,8	31	128,1	27,2	91	186,8	39,7	51	235,5	52,2
12	11,7	2,5	72	70,4	15,0	32	129,1	27,5	92	187,8	39,9	52	236,5	5,4
13	12,7	02,7	73	71,4	15,2	33	130,1	27,7	93	188,8	40,1	53	237,4	52,6
14	13,7	02,9	74	72,4	15,4	34	131,1	27,9	94	189,7	40,3	54	238,4	52,8
15	14,7	03,1	75	73,4	15,6	35	132,0	28,1	95	190,7	40,6	55	239,4	53,0
16	15,6	03,3	76	74,3	15,8	36	133,0	28,3	96	191,7	40,8	56	240,4	53,2
17	16,6	03,5	77	75,3	16,0	37	134,0	28,5	97	192,7	41,0	57	241,3	53,5
18	17,6	03,7	78	76,3	16,2	38	135,0	28,7	98	193,6	41,2	58	242,3	53,7
19	18,6	04,0	79	77,3	16,4	39	135,9	28,9	99	194,6	41,4	59	243,3	53,9
20	19,6	04,2	80	78,2	16,6	40	136,9	29,1	200	195,6	41,6	60	244,3	54,1
21	20,5	04,4	81	79,2	16,8	41	137,9	29,3	201	196,6	41,8	61	245,3	54,3
22	21,5	04,6	82	80,2	17,1	42	138,9	29,5	02	197,6	42,0	62	246,3	54,5
23	22,5	04,8	83	81,2	17,3	43	139,9	29,7	03	198,5	42,2	63	247,2	54,7
24	23,5	05,0	84	82,2	17,5	44	140,8	30,0	04	199,5	42,4	64	248,2	54,9
25	24,5	05,2	85	83,1	17,7	45	141,8	30,2	05	200,5	42,6	65	249,2	55,1
26	25,4	05,4	86	84,1	17,9	46	142,8	30,4	06	201,5	42,8	66	250,2	55,3
27	26,4	05,6	87	85,1	18,0	47	143,8	30,6	07	202,4	43,1	67	251,1	55,5
28	27,4	05,8	88	86,1	18,2	48	144,7	30,8	08	203,4	43,3	68	252,1	55,7
29	28,4	06,0	89	87,0	18,5	49	145,7	31,0	09	204,4	43,5	69	253,1	56,0
30	29,3	06,2	90	88,0	18,7	50	146,7	31,2	10	205,4	43,7	70	254,1	56,2
31	30,3	06,4	91	89,0	18,9	51	147,7	31,4	211	206,4	43,9	71	255,0	56,4
32	31,3	06,7	92	90,0	19,1	52	148,7	31,6	12	207,3	44,1	72	256,0	56,6
33	32,3	06,9	93	91,0	19,3	53	149,6	31,8	13	208,3	44,3	73	257,0	56,8
34	33,3	07,1	94	91,9	19,6	54	150,6	32,0	14	209,3	44,5	74	258,0	57,0
35	34,2	07,3	95	92,9	19,8	55	151,6	32,2	15	210,3	44,7	75	259,0	57,2
36	35,2	07,5	96	93,9	20,0	56	152,6	32,4	16	211,2	44,9	76	260,9	57,4
37	36,2	07,7	97	94,9	20,2	57	153,5	32,7	17	212,2	45,1	77	261,9	57,6
38	37,2	07,9	98	95,8	20,4	58	154,5	32,9	18	213,2	45,3	78	262,9	57,8
39	38,1	08,1	99	96,8	20,6	59	155,5	33,1	19	214,2	45,6	79	263,9	58,0
40	39,1	08,3	100	97,8	20,8	60	156,5	33,3	20	215,2	45,8	80	264,8	58,2
41	40,1	08,5	101	98,8	21,0	161	157,5	33,5	221	216,1	46,0	281	265,8	58,4
42	41,1	08,7	02	99,8	21,2	62	158,4	33,7	22	217,1	46,2	82	266,8	58,7
43	42,1	08,9	03	100,7	21,4	63	159,4	33,9	23	218,1	46,4	83	267,8	58,9
44	43,0	09,2	04	101,7	21,6	64	160,4	34,1	24	219,1	46,6	84	268,8	59,1
45	44,0	09,4	05	102,7	21,8	65	161,4	34,3	25	220,1	46,8	85	269,7	59,3
46	45,0	09,6	06	103,7	22,0	66	162,3	34,5	26	221,0	47,0	86	270,7	59,5
47	46,0	09,8	07	104,6	22,3	67	163,3	34,7	27	222,0	47,2	87	271,7	59,7
48	46,9	10,0	08	105,6	22,5	68	164,3	34,9	28	223,0	47,4	88	272,7	59,9
49	47,9	10,2	09	106,6	22,7	69	165,3	35,2	29	224,0	47,6	89	273,6	60,1
50	48,0	10,4	10	107,6	22,9	70	166,3	35,4	30	224,9	47,8	90	274,6	60,3
51	49,9	10,6	111	108,6	23,1	171	167,2	35,6	231	225,9	48,0	291	275,6	60,5
52	50,9	10,8	12	109,5	23,3	72	168,2	35,8	32	226,9	48,3	92	276,6	60,7
53	51,8	11,0	13	110,5	23,5	73	169,2	36,0	33	227,9	48,5	93	277,6	60,9
54	52,8	11,2	14	111,5	23,7	74	170,2	36,2	34	228,9	48,7	94	278,5	61,2
55	53,8	11,4	15	112,5	23,9	75	171,2	36,4	35	229,8	48,9	95	279,5	61,4
56	54,8	11,6	16	113,4	24,1	76	172,1	36,6	36	230,8	49,1	96	280,5	61,6
57	55,7	11,9	17	114,4	24,3	77	173,1	36,8	37	231,8	49,3	97	281,5	61,8
58	56,7	12,1	18	115,4	24,5	78	174,1	37,0	38	232,8	49,5	98	282,4	62,0
59	57,7	12,3	19	116,4	24,8	79	175,1	37,2	39	233,7	49,7	99	283,4	62,2
60	58,7	12,5	20	117,4	25,0	80	176,0	37,4	40	234,7	49,9	300	284,4	62,4
D.R.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 78 Deg.

Difference of Latitude and Departure for 13 Deg.

D	Lat.	Dep.	D	Lat.	Dep.	D	Lat.	Dep.	D	Lat.	Dep.	D	Lat.	Dep.
1	01,0	00,2	61	59,4	13,7	121	117,9	27,2	181	176,4	40,7	241	234,8	54,2
2	01,9	00,4	62	60,4	13,9	22	118,9	27,4	82	177,3	40,9	42	235,8	54,4
3	02,9	00,7	63	61,4	14,2	23	119,8	27,7	83	178,3	41,2	43	236,8	54,7
4	03,9	00,9	64	62,4	14,4	24	120,8	27,9	84	179,3	41,4	44	237,8	54,9
5	04,9	01,1	65	63,3	14,6	25	121,8	28,1	85	180,3	41,6	45	238,7	55,1
6	05,8	01,3	66	64,3	14,8	26	122,8	28,3	86	181,2	41,8	46	239,7	55,3
7	06,8	01,5	67	65,3	15,1	27	123,7	28,6	87	182,2	42,1	47	240,7	55,6
8	07,8	01,8	68	66,3	15,3	28	124,7	28,8	88	183,2	42,3	48	241,6	55,8
9	08,8	02,0	69	67,2	15,5	29	125,7	29,0	89	184,2	42,5	49	242,6	56,0
10	09,7	02,2	70	68,2	15,7	30	126,7	29,2	90	185,1	42,7	50	243,6	56,2
11	10,7	02,5	71	69,2	16,0	131	127,6	29,5	191	186,1	43,0	251	244,6	56,5
12	11,7	02,7	72	70,2	16,2	32	128,6	29,7	92	187,1	43,2	52	245,5	56,7
13	12,7	02,9	73	71,1	16,4	33	129,6	29,9	93	188,1	43,4	53	246,5	56,9
14	13,6	03,1	74	72,1	16,6	34	130,6	30,1	94	189,0	43,6	54	247,5	57,1
15	14,6	03,4	75	73,1	16,9	35	131,5	30,4	95	190,0	43,9	55	248,5	57,4
16	15,6	03,6	76	74,1	17,1	36	132,5	30,6	96	191,0	44,1	56	249,4	57,6
17	16,6	03,8	77	75,0	17,3	37	133,5	30,8	97	192,0	44,3	57	250,4	57,8
18	17,5	04,0	78	76,0	17,5	38	134,5	31,0	98	192,9	44,5	58	251,4	58,0
19	18,5	04,3	79	77,0	17,8	39	135,4	31,3	99	193,9	44,8	59	252,4	58,3
20	19,5	04,5	80	78,0	18,0	40	136,4	31,5	200	194,9	45,0	60	253,3	58,5
21	20,5	04,7	81	78,9	18,2	141	137,4	31,7	201	195,9	45,2	261	254,3	58,7
22	21,4	04,9	82	79,9	18,4	42	138,4	31,9	02	196,8	45,4	62	255,3	58,9
23	22,4	05,2	83	80,9	18,7	43	139,3	32,2	03	197,8	45,7	63	256,3	59,2
24	23,4	05,4	84	81,8	18,9	44	140,3	32,4	04	198,8	45,9	64	257,2	59,4
25	24,4	05,6	85	82,8	19,1	45	141,3	32,6	05	199,7	46,1	65	258,2	59,6
26	25,3	05,8	86	83,8	19,3	46	142,3	32,8	06	200,7	46,3	66	259,2	59,8
27	26,3	06,1	87	84,8	19,6	47	143,2	33,1	07	201,7	46,6	67	260,2	60,1
28	27,3	06,3	88	85,7	19,8	48	144,2	33,3	08	202,7	47,8	68	261,1	60,3
29	28,3	06,5	89	86,7	20,0	49	145,2	33,5	09	203,6	47,0	69	262,1	60,5
30	29,2	06,7	90	87,7	20,2	50	146,2	33,7	10	204,6	47,2	70	263,1	60,7
31	30,2	07,0	91	88,7	20,5	151	147,1	34,0	211	205,6	47,5	271	264,1	61,0
32	31,2	07,2	92	89,6	20,7	52	148,1	34,2	12	206,6	47,7	72	265,0	61,2
33	32,2	07,4	93	90,6	20,9	53	149,1	34,4	13	207,5	47,9	73	266,0	61,4
34	33,1	07,6	94	91,6	21,1	54	150,1	34,6	14	208,5	48,1	74	267,0	61,6
35	34,1	07,9	95	92,6	21,4	55	151,0	34,9	15	209,5	48,4	75	268,0	61,9
36	35,1	08,1	96	93,5	21,6	56	152,0	35,1	16	210,5	48,6	76	268,9	62,1
37	36,1	08,3	97	94,5	21,8	57	153,0	35,3	17	211,4	48,8	77	269,9	62,3
38	37,0	08,5	98	95,5	22,0	58	154,0	35,5	18	212,4	49,0	78	270,9	62,5
39	38,0	08,8	99	96,5	22,3	59	154,9	35,8	19	213,4	49,3	79	271,9	62,8
40	39,0	09,0	100	97,4	22,5	60	155,9	36,0	20	214,4	49,5	80	272,8	63,0
41	39,9	09,2	101	98,4	22,7	161	156,9	36,2	221	215,3	49,7	281	273,8	63,2
42	40,9	09,4	02	99,4	22,9	62	157,9	36,4	22	216,3	49,9	82	274,8	63,4
43	41,9	09,7	03	100,4	23,2	63	158,8	36,7	23	217,3	50,2	83	275,8	63,7
44	42,9	09,9	04	101,3	23,4	64	159,8	36,9	24	218,3	50,4	84	276,7	63,9
45	43,8	10,1	05	102,3	23,6	65	160,8	37,1	25	219,2	50,6	85	277,7	64,1
46	44,8	10,3	06	103,3	23,8	66	161,7	37,3	26	220,2	50,8	86	278,7	64,3
47	45,8	10,6	07	104,3	24,1	67	162,7	37,6	27	221,2	51,1	87	279,6	64,6
48	46,8	10,8	08	105,2	24,3	68	163,7	37,8	28	222,2	51,3	88	280,6	64,8
49	47,7	11,0	09	106,2	24,5	69	164,7	38,0	29	223,1	51,5	89	281,6	65,0
50	48,7	11,2	10	107,2	24,7	70	165,6	38,2	30	224,1	51,7	90	282,6	65,2
51	49,7	11,5	111	108,2	25,0	171	166,6	38,5	231	225,1	52,0	291	283,5	65,5
52	50,7	11,7	12	109,1	25,2	72	167,6	38,7	32	226,1	52,2	92	284,5	65,7
53	51,6	11,9	13	110,1	25,4	73	168,6	38,9	33	227,0	52,4	93	285,5	65,9
54	52,6	12,1	14	111,1	25,6	74	169,5	39,1	34	228,0	52,6	94	286,5	66,1
55	53,6	12,4	15	112,1	25,9	75	170,5	39,4	35	229,0	52,9	95	287,4	66,4
56	54,6	12,6	16	113,0	26,1	76	171,5	39,6	36	230,0	53,1	96	288,4	66,6
57	55,5	12,8	17	114,0	26,3	77	172,5	39,8	37	230,9	53,3	97	289,4	66,8
58	56,5	13,0	18	115,0	26,5	78	173,4	40,0	38	231,9	53,5	98	290,4	67,0
59	57,5	13,3	19	116,0	26,8	79	174,4	40,3	39	232,9	53,8	99	291,3	67,3
60	58,5	13,5	20	116,9	27,0	80	175,4	40,5	40	233,9	54,0	300	292,3	67,5
Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.

for 77 Deg.

Difference of Latitude and Departure for 14 Deg.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01,0	00,2	61	59,2	14,8	121	117,4	29,3	181	175,6	43,8	241	233,8	58,3
2	01,9	00,5	62	60,2	15,0	22	118,4	29,5	82	176,6	44,0	42	234,8	58,6
3	02,9	00,7	63	61,1	15,2	23	119,3	29,8	83	177,6	44,3	43	235,8	58,8
4	03,9	01,0	64	62,1	15,5	24	120,3	30,0	84	178,5	44,5	44	236,7	59,0
5	04,9	01,2	65	63,1	15,7	25	121,3	30,2	85	179,5	44,8	45	237,7	59,3
6	05,8	01,5	66	64,1	16,0	26	122,3	30,5	86	180,5	45,0	46	238,7	59,5
7	06,8	01,7	67	65,0	16,2	27	123,2	30,7	87	181,4	45,3	47	239,7	59,8
8	07,8	01,9	68	66,0	16,5	28	124,2	31,0	88	182,4	45,5	48	240,6	60,0
9	08,7	02,2	69	66,9	16,7	29	125,2	31,2	89	183,4	45,7	49	241,6	60,3
10	09,7	02,4	70	67,9	16,9	30	126,1	31,5	90	184,4	46,0	50	242,6	60,5
11	10,7	02,7	71	68,9	17,2	31	127,1	31,7	191	185,3	46,2	251	243,5	60,7
12	11,6	02,9	72	69,9	17,5	32	128,1	31,9	92	186,3	46,5	52	244,5	61,0
13	12,6	03,1	73	70,8	17,7	33	129,0	32,2	93	187,3	46,7	53	245,5	61,2
14	13,6	03,4	74	71,8	17,9	34	130,0	32,4	94	188,2	46,9	54	246,4	61,5
15	14,6	03,6	75	72,8	18,1	35	131,0	32,7	95	189,2	47,2	55	247,4	61,7
16	15,5	03,9	76	73,7	18,4	36	132,0	32,9	96	190,2	47,4	56	248,4	62,0
17	16,5	04,1	77	74,7	18,7	37	132,9	33,2	97	191,1	47,7	57	249,4	62,2
18	17,5	04,4	78	75,7	18,9	38	133,9	33,4	98	192,1	47,9	58	250,3	62,4
19	18,4	04,6	79	76,7	19,1	39	134,9	33,6	99	193,1	48,2	59	251,3	62,7
20	19,4	04,8	80	77,6	19,4	40	135,8	33,9	200	194,1	48,4	60	252,3	62,9
21	20,4	05,1	81	78,6	19,6	41	136,8	34,1	201	195,0	48,6	261	253,2	63,2
22	21,3	05,3	82	79,6	19,8	42	137,8	34,4	02	196,0	48,9	62	254,2	63,4
23	22,3	05,6	83	80,5	20,1	43	138,7	34,6	03	197,0	49,1	63	255,2	63,6
24	23,3	05,8	84	81,5	20,3	44	139,7	34,8	04	197,9	49,4	64	256,2	63,9
25	24,3	06,0	85	82,5	20,6	45	140,7	35,1	05	198,9	49,6	65	257,1	64,1
26	25,2	06,3	86	83,4	20,8	46	141,7	35,3	06	199,9	49,9	66	258,1	64,4
27	26,2	06,5	87	84,4	21,1	47	142,6	35,6	07	200,8	50,1	67	259,1	64,6
28	27,2	06,8	88	85,4	21,3	48	143,6	35,8	08	201,8	50,3	68	260,0	64,9
29	28,1	07,0	89	86,4	21,5	49	144,6	36,1	09	202,8	50,6	69	261,0	65,1
30	29,1	07,2	90	87,3	21,8	50	145,5	36,3	10	203,8	50,8	70	262,0	65,3
31	30,1	07,5	91	88,3	22,0	151	146,5	36,5	211	204,7	51,1	271	262,9	65,6
32	31,0	07,7	92	89,3	22,3	52	147,5	36,8	12	205,7	51,3	72	263,9	65,8
33	32,0	08,0	93	90,2	22,5	53	148,5	37,0	13	206,7	51,5	73	264,9	66,1
34	33,0	08,2	94	91,2	22,7	54	149,4	37,3	14	207,6	51,8	74	265,9	66,3
35	34,0	08,5	95	92,2	23,0	55	150,4	37,5	15	208,6	52,0	75	266,8	66,5
36	34,9	08,7	96	93,1	23,2	56	151,4	37,7	16	209,6	52,3	76	267,8	66,8
37	35,9	09,0	97	94,1	23,5	57	152,3	38,0	17	210,5	52,5	77	268,8	67,0
38	36,9	09,2	98	95,1	23,7	58	153,3	38,2	18	211,5	52,8	78	269,7	67,3
39	37,8	09,4	99	96,1	24,0	59	154,3	38,5	19	212,5	53,0	79	270,7	67,5
40	38,8	09,7	100	97,0	24,2	60	155,2	38,7	20	213,5	53,2	80	271,7	67,8
41	39,8	09,9	101	98,0	24,4	161	156,2	39,0	221	214,4	53,5	281	272,6	68,0
42	40,8	10,2	02	99,0	24,7	62	157,2	39,2	22	215,4	53,7	82	273,6	68,2
43	41,7	10,4	03	99,9	24,9	63	158,2	39,4	23	216,4	54,0	83	274,6	68,5
44	42,7	10,6	04	100,9	25,2	64	159,1	39,7	24	217,3	54,2	84	275,6	68,7
45	43,7	10,9	05	101,9	25,4	65	160,1	39,9	25	218,3	54,4	85	276,5	69,0
46	44,6	11,1	06	102,8	25,7	66	161,1	40,2	26	219,3	54,7	86	277,5	69,2
47	45,6	11,4	07	103,8	25,9	67	162,0	40,4	27	220,3	54,9	87	278,5	69,5
48	46,6	11,6	08	104,8	26,1	68	163,0	40,7	28	221,2	55,2	88	279,4	69,7
49	47,5	11,9	09	105,8	26,4	69	164,0	40,9	29	222,2	55,4	89	280,4	69,9
50	48,5	12,1	10	106,7	26,6	70	164,9	41,1	30	223,2	55,7	90	281,4	70,2
51	49,5	12,3	111	107,7	26,9	171	165,9	41,4	231	224,1	55,9	291	282,3	70,4
52	50,5	12,6	12	108,7	27,1	72	166,9	41,6	32	225,1	56,1	92	283,3	70,7
53	51,4	12,8	13	109,6	27,3	73	167,9	41,9	33	226,1	56,4	93	284,3	70,9
54	52,4	13,1	14	110,6	27,6	74	168,8	42,1	34	227,0	56,6	94	285,3	71,1
55	53,4	13,3	15	111,6	27,8	75	169,8	42,3	35	228,0	56,9	95	286,2	71,4
56	54,3	13,6	16	112,6	28,1	76	170,8	42,6	36	229,0	57,1	96	287,2	71,6
57	55,3	13,8	17	113,5	28,3	77	171,7	42,8	37	230,0	57,4	97	288,2	71,9
58	56,3	14,0	18	114,5	28,6	78	172,7	43,1	38	230,9	57,6	98	289,1	72,1
59	57,2	14,3	19	115,5	28,8	79	173,7	43,3	39	231,9	57,8	99	290,1	72,4
60	58,2	14,5	20	116,4	29,0	80	174,6	43,6	40	232,9	58,1	300	291,1	72,6
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 76 Deg.

Difference of Latitude and Departure for 15 Deg.

Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.
1	01,0	00,3	61	58,9	15,8	121	116,9	31,3	181	174,8	46,8	241	232,8	62,4
2	01,9	00,5	62	59,9	16,0	22	117,8	31,6	82	175,8	47,1	42	233,7	62,6
3	02,9	00,3	63	60,9	16,3	23	118,8	31,8	83	176,8	47,4	43	234,7	62,9
4	03,9	01,0	64	61,8	16,6	24	119,8	32,1	84	177,7	47,6	44	235,7	63,1
5	04,8	01,3	65	62,8	16,8	25	120,7	32,4	85	178,7	47,9	45	236,6	63,4
6	05,8	01,6	66	63,7	17,1	26	121,7	32,6	86	179,7	48,1	46	237,6	63,7
7	06,8	01,8	67	64,7	17,3	27	122,7	32,9	87	180,6	48,4	47	238,6	63,9
8	07,7	02,1	68	65,7	17,6	28	123,6	33,1	88	181,6	48,7	48	239,5	64,2
9	08,7	02,3	69	66,6	17,9	29	124,6	33,4	89	182,6	48,9	49	240,5	64,4
10	09,7	02,6	70	67,6	18,1	30	125,6	33,6	90	183,5	49,2	50	241,5	64,7
11	10,6	02,8	71	68,6	18,4	31	126,5	33,9	191	184,5	49,4	251	242,4	65,0
12	11,6	03,1	72	69,5	18,6	32	127,5	34,2	92	185,5	49,7	52	243,4	65,2
13	12,6	03,4	73	70,5	18,9	33	128,5	34,4	93	186,4	49,9	53	244,4	65,5
14	13,5	03,6	74	71,5	19,2	34	129,4	34,7	94	187,4	50,2	54	245,3	65,7
15	14,5	03,9	75	72,4	19,4	35	130,4	34,9	95	188,4	50,5	55	246,3	66,0
16	15,5	04,1	76	73,4	19,7	36	131,4	35,2	96	189,3	50,7	56	247,3	66,3
17	16,4	04,4	77	74,4	19,9	37	132,3	35,5	97	190,3	51,0	57	248,2	66,5
18	17,4	04,7	78	75,3	20,2	38	133,3	35,7	98	191,2	51,2	58	249,2	66,8
19	18,4	04,9	79	76,3	20,4	39	134,3	36,0	99	192,2	51,5	59	250,2	67,0
20	19,3	05,2	80	77,3	20,7	40	135,2	36,2	200	193,2	51,8	60	251,1	67,3
21	20,3	05,4	81	78,2	21,0	141	136,2	36,5	201	194,1	52,0	261	252,1	67,5
22	21,2	05,7	82	79,2	21,2	42	137,2	36,7	02	195,1	52,3	62	253,1	67,8
23	22,2	06,0	83	80,2	21,5	43	138,1	37,0	03	196,1	52,5	63	254,0	68,1
24	23,2	06,2	84	81,1	21,7	44	139,1	37,3	04	197,0	52,8	64	255,0	68,3
25	24,1	06,5	85	82,1	22,0	45	140,1	37,5	05	198,0	53,1	65	256,0	68,6
26	25,1	06,7	86	83,1	22,3	46	141,0	37,8	06	199,0	53,3	66	256,9	68,8
27	26,1	07,0	87	84,0	22,5	47	142,0	38,0	07	199,9	53,6	67	257,9	69,1
28	27,0	07,2	88	85,0	22,8	48	143,0	38,3	08	200,9	53,8	68	258,9	69,4
29	28,0	07,5	89	86,0	23,0	49	143,9	38,6	09	201,9	54,1	69	259,8	69,6
30	29,0	07,8	90	86,9	23,3	50	144,9	38,8	10	202,8	54,3	70	260,8	69,9
31	29,9	08,0	91	87,9	23,6	151	145,8	39,1	211	203,8	54,6	271	261,8	70,1
32	30,9	08,3	92	88,9	23,8	52	146,8	39,3	12	204,8	54,9	72	262,7	70,4
33	31,9	08,5	93	89,8	24,1	53	147,8	39,6	13	205,7	55,1	73	263,7	70,7
34	32,8	08,8	94	90,8	24,3	54	148,7	39,9	14	206,7	55,4	74	264,7	70,9
35	33,8	09,1	95	91,8	24,6	55	149,7	40,1	15	207,7	55,6	75	265,6	71,2
36	34,8	09,3	96	92,7	24,8	56	150,7	40,4	16	208,6	55,9	76	266,6	71,4
37	35,7	09,6	97	93,7	25,1	57	151,6	40,6	17	209,6	56,1	77	267,6	71,7
38	36,7	09,8	98	94,7	25,4	58	152,6	40,9	18	210,6	56,4	78	268,5	71,9
39	37,7	10,1	99	95,6	25,6	59	153,6	41,1	19	211,5	56,7	79	269,5	72,2
40	38,6	10,4	100	96,6	25,9	60	154,5	41,4	20	212,5	56,9	80	270,5	72,5
41	39,6	10,6	101	97,6	26,1	161	155,5	41,7	221	213,5	57,2	281	271,4	72,7
42	40,6	10,9	02	98,5	26,4	62	156,5	41,9	22	214,4	57,5	82	272,4	73,0
43	41,5	11,1	03	99,5	26,7	63	157,4	42,2	23	215,4	57,7	83	273,4	73,2
44	42,5	11,4	04	100,5	26,9	64	158,4	42,4	24	216,4	58,0	84	274,3	73,5
45	43,5	11,6	05	101,4	27,2	65	159,4	42,7	25	217,3	58,2	85	275,3	73,8
46	44,4	11,9	06	102,4	27,4	66	160,3	43,0	26	218,3	58,5	86	276,2	74,0
47	45,4	12,2	07	103,4	27,7	67	161,3	43,2	27	219,3	58,7	87	277,2	74,3
48	46,4	12,4	08	104,3	28,0	68	162,3	43,5	28	220,2	59,0	88	278,2	74,5
49	47,3	12,7	09	105,3	28,2	69	163,2	43,7	29	221,2	59,3	89	279,1	74,8
50	48,3	12,9	10	106,2	28,5	70	164,2	44,0	30	222,2	59,5	90	280,1	75,0
51	49,3	13,2	111	107,2	28,7	171	165,2	44,3	231	223,1	59,8	291	281,1	75,3
52	50,2	13,5	12	108,2	29,0	72	166,1	44,5	32	224,1	60,0	92	282,0	75,6
53	51,2	13,7	13	109,1	29,2	73	167,1	44,8	33	225,1	60,3	93	283,0	75,8
54	52,2	14,0	14	110,1	29,5	74	168,1	45,0	34	226,0	60,6	94	284,0	76,1
55	53,1	14,2	15	111,1	29,8	75	169,0	45,3	35	227,0	60,8	95	284,9	76,3
56	54,1	14,5	16	112,0	30,0	76	170,0	45,5	36	228,0	61,1	96	285,9	76,6
57	55,1	14,8	17	113,0	30,3	77	171,0	45,8	27	228,9	61,3	97	286,9	76,9
58	56,0	15,0	18	114,0	30,5	78	171,9	46,1	38	229,9	61,6	98	287,8	77,1
59	57,0	15,3	19	114,9	30,8	79	172,9	46,3	39	230,9	61,9	99	288,8	77,4
60	58,0	15,5	20	115,9	31,1	80	173,9	46,6	40	231,8	62,1	300	289,8	77,6
Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.

for 75 Deg.

Difference of Latitude and Departure for 16 Deg.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01,0	00,3	61	58,6	16,8	121	116,3	33,3	181	174,0	49,9	241	231,6	06,4	301	289,7	23,2
2	01,9	00,6	62	59,6	17,1	22	117,3	33,6	82	174,9	50,2	42	232,6	06,7	32	290,7	23,5
3	02,9	00,8	63	60,6	17,4	23	118,2	33,9	83	175,9	50,4	43	233,6	07,0	33	291,6	23,8
4	03,8	01,1	64	61,5	17,6	24	119,2	34,2	84	176,8	50,7	44	234,5	07,2	34	292,5	24,1
5	04,8	01,4	65	62,5	17,9	25	120,1	34,4	85	177,8	51,0	45	235,5	07,5	35	293,4	24,4
6	05,8	01,7	66	63,4	18,2	26	121,1	34,7	86	178,8	51,3	46	236,4	07,8	36	294,3	24,7
7	06,7	01,9	67	64,4	18,5	27	122,1	35,0	87	179,7	51,5	47	237,4	08,1	37	295,2	25,0
8	07,7	02,2	68	65,4	18,7	28	123,0	35,3	88	180,7	51,8	48	238,4	08,3	38	296,1	25,3
9	08,7	02,5	69	66,3	19,0	29	124,0	35,6	89	181,7	52,1	49	239,3	08,6	39	297,0	25,6
10	09,6	02,8	70	67,3	19,3	30	124,9	35,8	90	182,6	52,4	50	240,3	08,9	40	297,9	25,9
11	10,6	03,0	71	68,2	19,6	31	125,9	36,1	91	183,6	52,6	51	241,2	09,2	41	298,8	26,2
12	11,5	03,3	72	69,2	19,8	32	126,9	36,4	92	184,5	52,9	52	242,2	09,5	42	299,7	26,5
13	12,5	03,6	73	70,2	20,1	33	127,8	36,7	93	185,5	53,2	53	243,2	09,7	43	300,6	26,8
14	13,5	03,9	74	71,1	20,4	34	128,8	36,9	94	186,5	53,5	54	244,1	10,0	44	301,5	27,1
15	14,4	04,1	75	72,1	20,7	35	129,8	37,2	95	187,4	53,7	55	245,1	10,3	45	302,4	27,4
16	15,4	04,4	76	73,0	20,9	36	130,7	37,5	96	188,4	54,0	56	246,0	10,6	46	303,3	27,7
17	16,3	04,7	77	74,0	21,2	37	131,7	37,8	97	189,3	54,3	57	247,0	10,8	47	304,2	28,0
18	17,3	05,0	78	75,0	21,5	38	132,6	38,0	98	190,3	54,6	58	248,0	11,1	48	305,1	28,3
19	18,3	05,2	79	75,9	21,8	39	133,6	38,3	99	191,3	54,8	59	248,9	11,4	49	306,0	28,6
20	19,2	05,5	80	76,9	22,0	40	134,6	38,6	200	192,2	55,1	60	249,9	11,7	50	306,9	28,9
21	20,2	05,8	81	77,9	22,3	41	135,5	38,9	201	193,2	55,4	61	250,9	11,9	51	307,8	29,2
22	21,1	06,1	82	78,8	22,6	42	136,5	39,1	202	194,1	55,7	62	251,8	12,2	52	308,7	29,5
23	22,1	06,3	83	79,8	22,9	43	137,4	39,4	203	195,1	55,9	63	252,8	12,5	53	309,6	29,8
24	23,1	06,6	84	80,7	23,1	44	138,4	39,7	204	196,1	56,2	64	253,7	12,8	54	310,5	30,1
25	24,0	06,9	85	81,7	23,4	45	139,4	40,0	205	197,0	56,5	65	254,7	13,0	55	311,4	30,4
26	25,0	07,2	86	82,7	23,7	46	140,3	40,2	206	198,0	56,8	66	255,7	13,3	56	312,3	30,7
27	26,0	07,4	87	83,6	24,0	47	141,3	40,5	207	199,0	57,0	67	256,6	13,6	57	313,2	31,0
28	26,9	07,7	88	84,6	24,3	48	142,2	40,8	208	199,9	57,3	68	257,6	13,9	58	314,1	31,3
29	27,9	08,0	89	85,5	24,5	49	143,2	41,1	209	200,9	57,6	69	258,5	14,1	59	315,0	31,6
30	28,8	08,3	90	86,5	24,8	50	144,2	41,3	210	201,8	57,9	70	259,5	14,4	60	315,9	31,9
31	29,8	08,5	91	87,5	25,1	51	145,1	41,6	211	202,8	58,2	71	260,5	14,7	61	316,8	32,2
32	30,8	08,8	92	88,4	25,4	52	146,1	41,9	212	203,8	58,4	72	261,4	15,0	62	317,7	32,5
33	31,7	09,1	93	89,4	25,6	53	147,1	42,2	213	204,7	58,7	73	262,4	15,2	63	318,6	32,8
34	32,7	09,4	94	90,3	25,9	54	148,0	42,4	214	205,7	59,0	74	263,3	15,5	64	319,5	33,1
35	33,6	09,6	95	91,3	26,2	55	149,0	42,7	215	206,6	59,3	75	264,3	15,8	65	320,4	33,4
36	34,6	09,9	96	92,3	26,5	56	149,9	43,0	216	207,6	59,5	76	265,3	16,1	66	321,3	33,7
37	35,6	10,2	97	93,2	26,7	57	150,9	43,3	217	208,6	59,8	77	266,2	16,3	67	322,2	34,0
38	36,5	10,5	98	94,2	27,0	58	151,9	43,5	218	209,5	60,1	78	267,2	16,6	68	323,1	34,3
39	37,5	10,7	99	95,2	27,3	59	152,8	43,8	219	210,5	60,4	79	268,2	16,9	69	324,0	34,6
40	38,4	11,0	100	96,1	27,6	60	153,8	44,1	220	211,4	60,6	80	269,1	17,2	70	324,9	34,9
41	39,4	11,3	101	97,1	27,8	161	154,7	44,4	221	212,4	60,9	281	270,1	17,4	71	325,8	35,2
42	40,4	11,6	02	98,0	28,1	62	155,7	44,6	222	213,4	61,2	82	271,0	17,7	72	326,7	35,5
43	41,3	11,9	03	99,0	28,4	63	156,7	44,9	223	214,3	61,5	83	272,0	18,0	73	327,6	35,8
44	42,3	12,1	04	100,0	28,7	64	157,6	45,2	224	215,3	61,7	84	273,0	18,3	74	328,5	36,1
45	43,3	12,4	05	100,9	28,9	65	158,6	45,5	225	216,3	62,0	85	273,9	18,5	75	329,4	36,4
46	44,2	12,7	06	101,9	29,2	66	159,5	45,7	226	217,2	62,3	86	274,9	18,8	76	330,3	36,7
47	45,2	13,0	07	102,8	29,5	67	160,5	46,0	227	218,2	62,6	87	275,8	19,1	77	331,2	37,0
48	46,1	13,2	08	103,8	29,8	68	161,5	46,3	228	219,1	62,8	88	276,8	19,4	78	332,1	37,3
49	47,1	13,5	09	104,8	30,0	69	162,4	46,6	229	220,1	63,1	89	277,8	19,6	79	333,0	37,6
50	48,1	13,8	10	105,7	30,3	70	163,4	46,9	230	221,1	63,4	90	278,7	19,9	80	333,9	37,9
51	49,0	14,1	11	106,7	30,6	171	164,4	47,1	231	222,0	63,7	291	279,7	20,2	81	334,8	38,2
52	50,0	14,3	12	107,6	30,9	72	165,3	47,4	232	223,0	63,9	92	280,6	20,5	82	335,7	38,5
53	50,9	14,6	13	108,6	31,1	73	166,3	47,7	233	223,9	64,2	93	281,6	20,8	83	336,6	38,8
54	51,9	15,9	14	109,6	31,4	74	167,2	48,0	234	224,9	64,5	94	282,6	21,0	84	337,5	39,1
55	52,9	15,2	15	110,5	31,7	75	168,2	48,2	235	225,9	64,8	95	283,5	21,3	85	338,4	39,4
56	53,8	15,4	16	111,5	32,0	76	169,2	48,5	236	226,8	65,0	96	284,5	21,6	86	339,3	39,7
57	54,8	15,7	17	112,5	32,2	77	170,1	48,8	237	227,8	65,3	97	285,5	21,9	87	340,2	40,0
58	55,7	16,0	18	113,4	32,5	78	171,1	49,1	238	228,7	65,6	98	286,4	22,1	88	341,1	40,3
59	56,7	16,3	19	114,4	32,8	79	172,0	49,3	239	229,7	65,9	99	287,4	22,4	89	342,0	40,6
60	57,7	16,5	20	115,3	33,1	80	173,0	49,6	240	230,7	66,1	300	288,3	22,7	90	342,9	40,9
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 74 Deg.

Difference of Latitude and Departure for 17 Deg.

Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.
1	01,0	00,3	61	58,3	17,8	121	115,7	35,4	181	173,1	52,9	241	230,5	70,4
2	01,9	00,6	62	59,3	18,1	22	116,7	35,7	82	174,0	53,2	42	231,4	70,7
3	02,9	00,9	63	60,2	18,4	23	117,6	36,0	83	175,0	53,5	43	232,4	71,0
4	03,8	01,2	64	61,2	18,7	24	118,6	36,2	84	175,9	53,8	44	233,3	71,3
5	04,8	01,5	65	62,2	19,0	25	119,5	36,5	85	176,9	54,1	45	234,3	71,6
6	05,7	01,8	66	63,1	19,3	26	120,5	36,8	86	177,9	54,4	46	235,2	71,9
7	06,7	02,0	67	64,1	19,6	27	121,4	37,1	87	178,8	54,7	47	236,2	72,1
8	07,6	02,3	68	65,0	19,9	28	122,4	37,4	88	179,8	55,0	48	237,1	72,4
9	08,6	02,6	69	66,0	20,2	29	123,4	37,7	89	180,7	55,2	49	238,1	72,7
10	09,6	02,9	70	66,9	20,5	30	124,3	38,0	90	181,7	55,5	50	239,1	73,0
11	10,5	03,2	71	67,9	20,8	131	125,3	38,3	191	182,6	55,8	251	240,0	73,3
12	11,5	03,5	72	68,8	21,0	32	126,2	38,6	92	183,6	56,1	52	241,0	73,6
13	12,4	03,8	73	69,8	21,3	33	127,2	38,9	93	184,6	56,4	53	241,9	73,9
14	13,4	04,1	74	70,8	21,6	34	128,1	39,2	94	185,5	56,7	54	242,9	74,1
15	14,3	04,4	75	71,7	21,9	35	129,1	39,5	95	186,5	57,0	55	243,8	74,4
16	15,3	04,7	76	72,7	22,2	36	130,0	39,8	96	187,4	57,3	56	244,8	74,7
17	16,3	05,0	77	73,6	22,5	37	131,0	40,0	97	188,4	57,6	57	245,8	75,0
18	17,2	05,3	78	74,6	22,8	38	132,0	40,3	98	189,3	57,9	58	246,7	75,3
19	18,2	05,6	79	75,5	23,1	39	132,9	40,6	99	190,3	58,2	59	247,7	75,6
20	19,1	05,8	80	76,5	23,4	40	133,9	40,9	200	191,2	58,5	60	248,6	75,9
21	20,1	06,1	81	77,5	23,7	141	134,8	41,2	201	192,2	58,8	261	249,6	76,2
22	21,0	06,4	82	78,4	24,0	42	135,8	41,5	02	193,1	59,0	62	250,5	76,5
23	22,0	06,7	83	79,4	24,3	43	136,7	41,8	03	194,1	59,3	63	251,5	76,8
24	22,9	07,0	84	80,3	24,6	44	137,7	42,1	04	195,1	59,6	64	252,4	77,1
25	23,9	07,3	85	81,3	24,8	45	138,7	42,4	05	196,0	59,9	65	253,4	77,4
26	24,9	07,6	86	82,2	25,1	46	139,6	42,7	06	197,0	60,2	66	254,4	77,7
27	25,8	07,9	87	83,2	25,4	47	140,6	43,0	07	197,9	60,5	67	255,3	77,9
28	26,8	08,2	88	84,1	25,7	48	141,5	43,3	08	198,9	60,8	68	256,3	78,2
29	27,7	08,5	89	85,1	26,0	49	142,5	43,6	09	199,9	61,1	69	257,2	78,5
30	28,7	08,8	90	86,1	26,3	50	143,4	43,8	10	200,8	61,4	70	258,2	78,8
31	29,6	09,1	91	87,0	26,6	151	144,4	44,1	211	201,8	61,7	271	259,1	79,1
32	30,6	09,4	92	88,0	26,9	52	145,3	44,4	12	202,7	62,0	72	260,1	79,4
33	31,6	09,6	93	88,9	27,2	53	146,3	44,7	13	203,7	62,3	73	261,1	79,7
34	32,5	09,9	94	89,9	27,5	54	147,3	45,0	14	204,6	62,6	74	262,0	80,0
35	33,5	10,2	95	90,8	27,8	55	148,2	45,3	15	205,6	62,8	75	263,0	80,3
36	34,4	10,5	96	91,8	28,1	56	149,2	45,6	16	206,5	63,1	76	263,9	80,6
37	35,4	10,8	97	92,8	28,4	57	150,1	45,9	17	207,5	63,4	77	264,9	80,9
38	36,3	11,1	98	93,7	28,6	58	151,1	46,2	18	208,5	63,7	78	265,8	81,2
39	37,3	11,4	99	94,7	28,9	59	152,0	46,5	19	209,4	64,0	79	266,8	81,5
40	38,2	11,7	100	95,6	29,2	60	152,0	46,8	20	210,4	64,3	80	267,7	81,7
41	39,2	12,0	101	96,6	29,5	161	154,0	47,1	221	211,3	64,6	281	268,7	82,0
42	40,2	12,3	02	97,5	29,8	62	154,9	47,4	22	212,3	64,9	82	269,7	82,3
43	41,1	12,6	03	98,5	30,1	63	155,9	47,7	23	213,2	65,2	83	270,6	82,6
44	42,1	13,0	04	99,4	30,4	64	156,8	47,9	24	214,2	65,5	84	271,6	82,9
45	43,0	13,2	05	100,4	30,7	65	157,8	48,2	25	215,2	65,8	85	272,5	83,2
46	44,0	13,4	06	101,4	31,0	66	158,7	48,5	26	216,1	66,1	86	273,5	83,5
47	44,9	13,7	07	102,3	31,3	67	159,7	48,8	27	217,1	66,4	87	274,4	83,8
48	45,9	14,0	08	103,3	31,6	68	160,6	49,1	28	218,0	66,6	88	275,4	84,1
49	46,9	14,3	09	104,2	31,9	69	161,6	49,4	29	219,0	66,9	89	276,4	84,4
50	47,8	14,6	10	105,2	32,2	70	162,6	49,7	30	219,9	67,2	90	277,3	84,7
51	48,8	14,9	111	106,1	32,4	171	163,5	50,0	231	220,9	67,5	291	278,3	85,0
52	49,7	15,2	12	107,1	32,7	72	164,5	50,3	32	221,8	67,8	92	279,2	85,3
53	50,7	15,5	13	108,1	33,0	73	165,4	50,6	33	222,8	68,1	93	280,2	85,5
54	51,6	15,8	14	109,0	33,3	74	166,4	50,9	34	223,8	68,4	94	281,1	85,8
55	52,6	16,1	15	110,0	33,6	75	167,3	51,2	35	224,7	68,7	95	282,1	86,1
56	53,5	16,4	16	110,9	33,9	76	168,3	51,4	36	225,7	69,0	96	283,0	86,4
57	54,5	16,7	17	111,9	34,2	77	169,3	51,7	37	226,6	69,3	97	284,0	86,7
58	55,5	17,0	18	112,8	34,5	78	170,2	52,0	38	227,6	69,6	98	285,0	87,0
59	56,4	17,2	19	113,8	34,8	79	171,2	52,3	39	228,5	69,9	99	285,9	87,3
60	57,4	17,5	20	114,7	35,1	80	172,1	52,6	40	229,5	70,2	300	286,9	87,6
Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.

Difference of Latitude and Departure for 18 Deg.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01,0	00,3	61	58,0	18,8	121	115,1	37,4	181	172,1	55,9	241	229,2	74,5
2	01,9	00,6	62	59,0	19,2	22	116,0	37,7	82	173,1	56,2	42	230,1	74,8
3	02,9	00,9	63	59,9	19,5	23	117,0	38,0	83	174,0	56,5	43	231,1	75,1
4	03,8	01,2	64	60,9	19,8	24	117,9	38,3	84	175,0	56,9	44	232,0	75,4
5	04,8	01,5	65	61,8	20,1	25	118,9	38,6	85	175,9	57,2	45	233,0	75,7
6	05,7	01,9	66	62,8	20,4	26	119,8	38,9	86	176,9	57,5	46	233,9	76,0
7	06,7	02,2	67	63,7	20,7	27	120,8	39,2	87	177,8	57,8	47	234,9	76,3
8	07,6	02,5	68	64,7	21,0	28	121,7	39,6	88	178,8	58,1	48	235,8	76,6
9	08,6	02,8	69	65,6	21,3	29	122,7	39,9	89	179,7	58,4	49	236,8	76,9
10	09,5	03,1	70	66,6	21,6	30	123,6	40,2	90	180,7	58,7	50	237,8	77,2
11	10,5	03,4	71	67,5	21,9	131	124,6	40,5	191	181,6	59,0	251	238,7	77,6
12	11,4	03,7	72	68,5	22,2	32	125,5	40,8	92	182,6	59,3	52	239,7	77,9
13	12,4	04,0	73	69,4	22,6	33	126,5	41,1	93	183,5	59,6	53	240,6	78,2
14	13,3	04,3	74	70,4	22,9	34	127,4	41,4	94	184,5	59,9	54	241,6	78,5
15	14,3	04,6	75	71,3	23,2	35	128,4	41,7	95	185,4	60,3	55	242,5	78,8
16	15,2	04,9	76	72,3	23,5	36	129,3	42,0	96	186,4	60,6	56	243,5	79,1
17	16,2	05,3	77	73,2	23,8	37	130,3	42,3	97	187,3	60,9	57	244,4	79,4
18	17,1	05,6	78	74,2	24,1	38	131,2	42,6	98	188,3	61,2	58	245,4	79,7
19	18,1	05,9	79	75,1	24,4	39	132,2	43,0	99	189,2	61,5	59	246,3	80,0
20	19,0	06,2	80	76,1	24,7	40	133,1	43,3	200	190,2	61,8	60	247,3	80,3
21	20,0	06,5	81	77,0	25,0	141	134,1	43,6	201	191,2	62,1	261	248,2	80,6
22	20,9	06,8	82	78,0	25,3	42	135,0	43,9	02	192,1	62,4	62	249,2	81,0
23	21,9	07,1	83	78,9	25,6	43	136,0	44,2	03	193,1	62,7	63	250,1	81,3
24	22,8	07,4	84	79,9	26,0	44	136,9	44,5	04	194,0	63,0	64	251,1	81,6
25	23,8	07,7	85	80,8	26,3	45	137,9	44,8	05	195,0	63,3	65	252,0	81,9
26	24,7	08,0	86	81,8	26,6	46	138,8	45,1	06	195,9	63,7	66	253,0	82,2
27	25,7	08,3	87	82,7	26,9	47	139,8	45,4	07	196,9	64,0	67	253,9	82,5
28	26,6	08,7	88	83,7	27,2	48	140,7	45,7	08	197,8	64,3	68	254,9	82,8
29	27,6	09,0	89	84,6	27,5	49	141,7	46,0	09	198,8	64,6	69	255,8	83,1
30	28,5	09,3	90	85,6	27,8	50	142,7	46,4	10	199,7	64,9	70	256,8	8

for 72 Deg

Difference of Latitude and Departure for 19 Deg.

Diff.	Lat.	Dep.	Diff.	Lat.	Dep.	Diff.	Lat.	Dep.	Diff.	Lat.	Dep.	Diff.	Lat.	Dep.
1	00,9	00,3	61	57,7	19,9	121	114,4	39,4	181	171,1	58,9	241	227,9	78,5
2	01,9	00,7	62	58,6	20,2	22	115,3	39,7	82	172,1	59,3	42	228,8	78,8
3	02,8	01,0	63	59,6	20,5	23	116,3	40,0	83	173,0	59,6	43	229,7	79,1
4	03,8	01,3	64	60,5	20,8	24	117,2	40,4	84	174,0	59,9	44	230,7	79,4
5	04,7	01,6	65	61,5	21,2	25	118,2	40,7	85	174,9	60,2	45	231,6	79,8
6	05,7	02,0	66	62,4	21,5	26	119,1	41,0	86	175,9	60,6	46	232,6	80,1
7	06,6	02,3	67	63,3	21,8	27	120,1	41,4	87	176,8	60,9	47	233,5	80,4
8	07,6	02,6	68	64,3	22,1	28	121,0	41,7	88	177,7	61,2	48	234,5	80,7
9	08,5	02,9	69	65,2	22,5	29	122,0	42,0	89	178,7	61,5	49	235,4	81,1
10	09,5	03,3	70	66,2	22,8	30	122,9	42,3	90	179,6	61,9	50	236,4	81,4
11	10,4	03,6	71	67,1	23,1	131	123,9	42,7	191	180,6	62,2	251	237,3	81,7
12	11,3	03,9	72	68,1	23,4	32	124,8	43,0	92	181,5	62,5	52	238,3	82,1
13	12,3	04,2	73	69,0	23,8	33	125,7	43,3	93	182,5	62,8	53	239,2	82,4
14	13,2	04,6	74	70,0	24,1	34	126,7	43,6	94	183,4	63,2	54	240,1	82,7
15	14,2	04,9	75	70,9	24,4	35	127,6	44,0	95	184,4	63,5	55	241,1	83,0
16	15,1	05,2	76	71,9	24,7	36	128,6	44,3	96	185,3	63,8	56	242,0	83,4
17	16,1	05,5	77	72,8	25,1	37	129,5	44,6	97	186,3	64,1	57	243,0	83,7
18	17,0	05,9	78	73,7	25,4	38	130,5	44,9	98	187,2	64,5	58	243,9	84,0
19	18,0	06,2	79	74,7	25,7	39	131,4	45,3	99	188,1	64,8	59	244,9	84,3
20	18,9	06,5	80	75,6	26,0	40	132,4	45,6	200	189,1	65,1	60	245,8	84,7
21	19,9	06,8	81	76,6	26,4	141	133,3	45,9	201	190,0	65,4	261	246,8	85,0
22	20,8	07,2	82	77,5	26,7	42	134,3	46,2	02	191,0	65,8	62	247,7	85,3
23	21,7	07,5	83	78,5	27,0	43	135,2	46,6	03	191,9	66,1	63	248,7	85,6
24	22,7	07,8	84	79,4	27,4	44	136,1	46,9	04	192,9	66,4	64	249,6	86,0
25	23,6	08,1	85	80,4	27,7	45	137,1	47,2	05	193,8	66,7	65	250,5	86,3
26	24,6	08,5	86	81,3	28,0	46	138,0	47,5	06	194,8	67,1	66	251,5	86,6
27	25,5	08,8	87	82,3	28,3	47	139,0	47,9	07	195,7	67,4	67	252,4	86,9
28	26,5	09,1	88	83,2	28,7	48	139,9	48,2	08	196,7	67,7	68	253,4	87,3
29	27,4	09,4	89	84,1	29,0	49	140,9	48,5	09	197,6	68,1	69	254,3	87,6
30	28,4	09,8	90	85,1	29,3	50	141,8	48,8	10	198,5	68,4	70	255,3	87,9
31	29,3	10,1	91	86,0	29,6	51	142,8	49,2	211	199,5	68,7	271	256,2	88,2
32	30,3	10,4	92	87,0	30,0	52	143,7	49,5	12	200,4	69,0	72	257,2	88,6
33	31,2	10,7	93	87,9	30,3	53	144,7	49,8	13	201,4	69,4	73	258,1	88,9
34	32,1	11,1	94	88,9	30,6	54	145,6	50,1	14	202,3	69,7	74	259,1	89,2
35	33,1	11,4	95	89,8	30,9	55	146,5	50,5	15	203,3	70,0	75	260,0	89,5
36	34,0	11,7	96	90,8	31,3	56	147,5	50,8	16	204,2	70,3	76	260,9	89,9
37	35,0	12,0	97	91,7	31,6	57	148,4	51,1	17	205,2	70,7	77	261,9	90,2
38	35,9	12,4	98	92,7	31,9	58	149,4	51,4	18	206,1	71,0	78	262,8	90,5
39	36,9	12,7	99	93,6	32,2	59	150,3	51,8	19	207,1	71,3	79	263,8	90,8
40	37,8	13,0	100	94,5	32,6	60	151,3	52,1	20	208,0	71,6	80	264,7	91,2
41	38,8	13,3	101	95,5	32,9	161	152,2	52,4	221	208,9	72,0	281	265,7	91,5
42	39,7	13,7	02	96,4	33,2	62	153,2	52,7	22	209,9	72,3	82	266,6	91,8
43	40,7	14,0	03	97,4	33,5	63	154,1	53,1	23	210,8	72,6	83	267,6	92,1
44	41,6	14,3	04	98,3	33,9	64	155,1	53,4	24	211,8	72,9	84	268,5	92,5
45	42,5	14,7	05	99,3	34,2	65	156,0	53,7	25	212,7	73,3	85	269,5	92,8
46	43,5	15,0	06	100,2	34,5	66	156,9	54,0	26	213,7	73,6	86	270,4	93,1
47	44,4	15,3	07	101,2	34,8	67	157,9	54,4	27	214,6	73,9	87	271,3	93,4
48	45,4	15,6	08	102,1	35,2	68	158,8	54,7	28	215,6	74,2	88	272,3	93,8
49	46,3	16,0	09	103,1	35,5	69	159,8	55,0	29	216,5	74,6	89	273,2	94,1
50	47,3	16,3	10	104,0	35,8	70	160,7	55,4	30	217,5	74,9	90	274,2	94,4
51	48,2	16,6	111	104,9	36,1	171	161,7	55,7	231	218,4	75,2	291	275,1	94,7
52	49,2	16,9	12	105,9	36,5	72	162,6	56,0	32	219,3	75,5	92	276,1	95,1
53	50,1	17,3	13	106,8	36,8	73	163,6	56,3	33	220,3	75,9	93	277,0	95,4
54	51,1	17,6	14	107,8	37,1	74	164,5	56,7	34	221,2	76,2	94	278,0	95,7
55	52,0	17,9	15	108,7	37,4	75	165,5	57,0	35	222,2	76,5	95	278,9	96,1
56	52,9	18,2	16	109,7	37,8	76	166,4	57,3	36	223,1	76,8	96	279,9	96,4
57	53,9	18,6	17	110,6	38,1	77	167,3	57,6	37	224,1	77,2	97	280,8	96,7
58	54,8	18,9	18	111,6	38,4	78	168,3	58,0	38	225,0	77,5	98	281,7	97,0
59	55,8	19,2	19	112,5	38,7	79	169,2	58,3	39	226,0	77,8	99	282,7	97,4
60	56,7	19,5	20	113,5	39,1	80	170,2	58,6	40	226,9	78,1	300	283,6	97,7
Diff.	Dep.	Lat.	Diff.	Dep.	Lat.	Diff.	Dep.	Lat.	Diff.	Dep.	Lat.	Diff.	Dep.	Lat.

Difference of Latitude and Departure for 20 Deg.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00,9	00,3	61	57,3	09	121	115,7	43,7	181	170,1	61,3	241	226,5	82,4
2	01,9	00,7	62	58,3	21,2	122	114,6	45,7	182	171,0	62,2	242	227,4	82,8
3	02,8	01,0	63	59,2	21,8	123	115,6	42,1	183	172,0	62,6	243	228,3	83,1
4	03,8	01,4	64	60,1	21,0	124	116,5	2,4	184	172,9	62,9	244	229,3	83,4
5	04,7	01,7	65	61,1	22,2	125	117,5	42,8	185	173,8	63,1	245	230,2	83,8
6	05,7	02,1	66	62,0	22,6	126	118,4	43,1	186	174,8	63,6	246	231,2	84,1
7	06,6	2,2	67	63,0	22,9	127	119,3	43,4	187	175,7	64,0	247	232,1	84,5
8	07,6	2,7	68	63,9	23,3	128	120,3	43	188	176,7	64,3	248	233,0	84,8
9	08,5	3,1	69	64,8	23,6	129	121,2	44,1	189	177,6	64,7	249	234,0	85,2
10	09,4	03,4	70	65,7	24	130	122,2	44,5	190	178,5	65,0	250	234,9	85,5
11	10,3	03,8	71	66,7	24,3	131	123,1	44,0	191	179,5	65,5	251	235,8	85,8
12	11,3	04,1	72	67,7	24,6	132	124,0	45,1	192	180,4	65,7	252	236,8	86,2
13	12,2	04,4	73	68,6	25,0	133	125,0	45,5	193	181,4	66,0	253	237,7	86,5
14	13,2	04,8	74	69,5	25,3	134	125,9	45	194	182,3	66,3	254	238,7	86,9
15	14,1	05,1	75	70,5	25,7	135	126,8	46,2	195	183,2	66,7	255	239,6	87,2
16	15,0	05,5	76	71,4	26,0	136	127,8	46,5	196	184,2	67,0	256	240,6	87,6
17	16,0	05,8	77	72,4	26,3	137	128,7	46,9	197	185,1	67,4	257	241,5	87,9
18	16,9	06,2	78	73,3	26,7	138	129,7	47,2	198	186,1	67,7	258	242,4	88,2
19	17,9	06,5	79	74,2	27,0	139	130,6	47,5	199	187,0	68,1	259	243,4	88,6
20	18,8	06,8	80	75,2	27,4	140	131,5	47,0	200	187,9	68,4	260	244,3	88,9
21	19,7	07,2	81	76,1	27,7	141	132,5	48,2	201	188,9	68,7	261	245,3	89,3
22	20,7	07,5	82	77,1	28,0	142	133,4	48,6	202	189,8	69,1	262	246,2	89,6
23	21,6	07,9	83	78,0	28,4	143	134,4	48,9	203	190,8	69,4	263	247,1	89,9
24	22,6	08,2	84	78,9	28,7	144	135,3	49,2	204	191,7	69,5	264	248,1	90,3
25	23,5	08,6	85	79,9	29,1	145	136,3	49,6	205	192,6	70,1	265	249,0	90,6
26	24,4	08,9	86	80,8	29,4	146	137,2	49,9	206	193,5	70,5	266	250,0	91,0
27	25,4	09,2	87	81,8	29,8	147	138,1	50,2	207	194,5	70,8	267	250,9	91,3
28	26,3	09,6	88	82,7	30,1	148	139,1	50,6	208	195,5	71,1	268	251,8	91,7
29	27,3	09,9	89	83,6	30,5	149	140,0	51,0	209	196,4	71,5	269	252,8	92,0
30	28,2	10,3	90	84,6	30,8	150	141,0	51,3	210	197,3	71,8	270	253,7	92,4
31	29,1	10,6	91	85,5	31,1	151	141,9	51,6	211	198,3	72,2	271	254,7	92,7
32	30,1	10,9	92	86,5	31,5	152	142,8	52,0	212	199,2	72,5	272	255,6	93,0
33	31,0	11,3	93	87,4	31,8	153	143,8	52,3	213	200,2	72,8	273	256,5	93,4
34	31,9	11,6	94	88,3	32,1	154	144,7	52,7	214	201,1	73,2	274	257,5	93,7
35	32,9	12,0	95	89,3	32,5	155	145,7	53,0	215	202,0	73,5	275	258,4	94,1
36	33,8	12,3	96	90,2	32,8	156	146,6	53,4	216	203,0	73,9	276	259,4	94,4
37	34,8	12,7	97	91,2	33,2	157	147,5	53,7	217	203,9	74,2	277	260,3	94,7
38	35,7	13,0	98	92,1	33,5	158	148,5	54,0	218	204,9	74,6	278	261,2	94,1
39	36,6	13,3	99	93,0	33,9	159	149,4	54,4	219	205,7	74,9	279	262,2	95,4
40	37,6	13,7	100	94,0	34,2	160	150,4	54,7	220	206,7	75,2	280	263,1	95,8
41	38,5	14,0	101	94,9	34,5	161	151,3	55,1	221	207,7	75,6	281	264,1	96,1
42	39,5	14,4	102	95,8	34,9	162	152,2	55,5	222	208,6	75,9	282	265,0	96,4
43	40,4	14,7	103	96,8	35,2	163	153,2	55,7	223	209,6	76,3	283	265,9	96,7
44	41,3	15,0	104	97,7	35,6	164	154,1	56,1	224	210,5	76,6	284	266,9	97,1
45	42,3	15,4	105	98,7	35,9	165	155,1	56,4	225	211,4	77,0	285	267,8	97,5
46	43,2	15,7	106	99,6	36,3	166	156,0	56,8	226	212,4	77,3	286	268,8	97,8
47	44,2	16,1	107	100,5	36,6	167	156,9	57,1	227	213,3	77,6	287	269,7	98,2
48	45,1	16,4	108	101,5	36,9	168	157,9	57,5	228	214,3	78,0	288	270,6	98,5
49	46,0	16,8	109	102,4	37,3	169	158,8	57,8	229	215,2	78,3	289	271,6	98,8
50	47,0	17,1	110	103,4	37,6	170	159,7	58,1	230	216,1	78,7	290	272,5	99,2
51	47,9	17,4	111	104,3	38,0	171	160,7	58,5	231	217,1	79,0	291	273,5	99,5
52	48,9	17,8	112	105,2	38,3	172	161,6	58,8	232	218,0	79,3	292	274,4	99,9
53	49,8	18,1	113	106,2	38,6	173	162,6	59,2	233	219,0	79,7	293	275,3	100,2
54	50,7	18,5	114	107,1	39,0	174	163,5	59,5	234	219,9	80,0	294	276,3	100,5
55	51,7	18,8	115	108,1	39,3	175	164,4	59,9	235	220,8	80,4	295	277,2	100,9
56	52,6	19,2	116	109,0	39,7	176	165,4	60,2	236	221,8	80,7	296	278,2	101,1
57	53,6	19,5	117	109,9	40,9	177	166,3	60,5	237	222,7	81,1	297	279,1	101,6
58	54,5	19,8	118	110,9	40,4	178	167,3	60,9	238	223,6	81,4	298	280,0	101,9
59	55,4	20,2	119	111,8	40,7	179	168,2	61,2	239	224,6	81,7	299	281,0	102,3
60	56,4	20,5	120	112,8	41,0	180	169,1	61,6	240	225,5	82,1	300	281,9	102,6
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 20 Deg.

Difference of Latitude and Departure for 21 Deg.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00,9	00,4	61	56,9	21,9	121	113,0	43,4	181	169,0	64,9	241	225,0	86,4
2	01,9	00,7	62	57,9	22,2	22	113,9	43,7	82	169,9	65,2	42	225,9	86,7
3	02,8	01,1	63	58,8	22,6	23	114,9	44,1	83	170,9	65,6	43	226,9	87,1
4	03,7	01,4	64	59,7	22,9	24	115,8	44,4	84	171,8	65,9	44	227,8	87,4
5	04,7	01,8	65	60,7	23,3	25	116,7	44,8	85	172,7	66,3	45	228,7	87,8
6	05,6	02,2	66	61,6	23,7	26	117,7	45,2	86	173,7	66,7	46	229,7	88,2
7	06,5	02,5	67	62,5	24,0	27	118,6	45,5	87	174,6	67,0	47	230,6	88,5
8	07,5	02,9	68	63,5	24,4	28	119,5	45,9	88	175,5	67,4	48	231,5	88,9
9	08,4	03,2	69	64,4	24,7	29	120,5	46,2	89	176,5	67,7	49	232,5	89,2
10	09,3	03,6	70	65,3	25,1	30	121,4	46,6	90	177,4	68,1	50	233,4	89,6
11	10,3	03,9	71	66,3	25,4	31	122,3	47,0	191	178,3	68,5	251	234,3	90,0
12	11,2	04,3	72	67,2	25,8	32	123,3	47,3	92	179,3	68,8	52	235,3	90,3
13	12,1	04,7	73	68,1	26,2	33	124,2	47,7	93	180,2	69,2	53	236,2	90,7
14	13,1	05,0	74	69,1	26,5	34	125,1	48,0	94	181,1	69,5	54	237,1	91,0
15	14,0	05,4	75	70,0	26,9	35	126,1	48,4	95	182,1	69,9	55	238,1	91,4
16	14,9	05,7	76	70,9	27,2	36	127,0	48,7	96	183,0	70,2	56	239,0	91,8
17	15,9	06,1	77	71,9	27,6	37	127,9	49,1	97	183,9	70,6	57	239,9	92,1
18	16,8	06,5	78	72,8	28,0	38	128,9	49,5	98	184,9	71,0	58	240,9	92,5
19	17,7	06,8	79	73,7	28,3	39	129,8	49,8	99	185,8	71,3	59	241,8	92,8
20	18,7	07,2	80	74,7	28,7	40	130,7	50,2	200	186,7	71,7	60	242,7	93,2
21	19,6	07,5	81	75,6	29,0	141	131,7	50,5	201	187,6	72,0	261	243,7	93,5
22	20,5	07,9	82	76,5	29,4	42	132,6	50,9	02	188,6	72,4	62	244,6	93,9
23	21,5	08,2	83	77,5	29,7	43	133,5	51,3	03	189,5	72,8	63	245,5	94,3
24	22,4	08,6	84	78,4	30,1	44	134,5	51,6	04	190,4	73,1	64	246,5	94,6
25	23,3	09,0	85	79,3	30,5	45	135,4	52,0	05	191,4	73,5	65	247,4	95,0
26	24,3	09,3	86	80,3	30,8	46	136,3	52,3	06	192,3	73,8	66	248,3	95,3
27	25,2	09,7	87	81,2	31,2	47	137,3	52,7	07	193,2	74,5	67	249,3	95,7
28	26,1	10,0	88	82,1	31,5	48	138,2	53,0	08	194,2	74,2	68	250,2	96,1
29	27,1	10,4	89	83,1	31,9	49	139,1	53,4	09	195,1	74,9	69	251,1	96,4
30	28,0	10,8	90	84,0	32,3	50	140,1	53,8	10	196,0	75,3	70	252,1	96,8
31	28,9	11,1	91	84,9	32,6	151	141,0	54,1	211	197,0	75,6	271	253,0	97,1
32	29,9	11,5	92	85,9	33,0	52	141,9	54,5	12	197,9	76,0	72	253,9	97,5
33	30,8	11,8	93	86,8	33,3	53	142,9	54,8	13	198,8	76,3	73	254,9	97,8
34	31,7	12,2	94	87,7	33,7	54	143,8	55,2	14	199,8	76,7	74	255,8	98,2
35	32,7	12,5	95	88,7	34,0	55	144,7	55,6	15	200,7	77,1	75	256,7	98,6
36	33,6	12,9	96	89,6	34,4	56	145,7	55,9	16	201,6	77,4	76	257,7	98,9
37	34,5	13,3	97	90,5	34,8	57	146,6	56,3	17	202,6	77,8	77	258,6	99,3
38	35,5	13,6	98	91,5	35,1	58	147,5	56,6	18	203,5	78,1	78	259,5	99,6
39	36,4	14,0	99	92,4	35,5	59	148,5	57,0	19	204,4	78,5	79	260,5	100,0
40	37,3	14,3	100	93,4	35,8	60	149,4	57,3	20	205,4	78,8	80	261,4	100,4
41	38,3	14,7	101	94,3	36,2	161	150,3	57,7	221	206,3	79,2	281	262,3	100,7
42	39,2	15,1	02	95,3	36,6	62	151,3	58,1	22	207,2	79,6	82	263,3	101,1
43	40,1	15,4	03	96,2	36,9	63	152,2	58,4	23	208,2	79,9	83	264,2	101,4
44	41,1	15,8	04	97,1	37,3	64	153,1	58,8	24	209,1	80,3	84	265,1	101,8
45	42,0	16,1	05	98,1	37,6	65	154,1	59,1	25	210,0	80,6	85	266,1	102,1
46	42,9	16,5	06	99,0	38,0	66	155,0	59,5	26	211,0	81,0	86	267,0	102,5
47	43,9	16,8	07	99,9	38,3	67	155,9	59,9	27	211,9	81,4	87	267,9	102,9
48	44,8	17,2	08	100,9	38,7	68	156,9	60,2	28	212,8	81,7	88	268,9	103,2
49	45,7	17,6	09	101,8	39,1	69	157,8	60,6	29	213,8	82,1	89	269,8	103,6
50	46,7	17,9	10	102,7	39,4	70	158,7	60,9	30	214,7	82,4	90	270,7	103,9
51	47,6	18,3	111	103,7	39,8	171	159,7	61,3	231	215,6	82,8	291	271,7	104,3
52	48,5	18,6	12	104,6	40,1	72	160,6	61,6	32	216,6	83,1	92	272,6	104,7
53	49,5	19,0	13	105,5	40,5	73	161,5	62,0	33	217,5	83,5	93	273,5	105,0
54	50,4	19,4	14	106,5	40,9	74	162,5	62,4	34	218,4	83,9	94	274,5	105,4
55	51,3	19,7	15	107,4	41,2	75	163,4	62,7	35	219,4	84,2	95	275,4	105,7
56	52,3	20,1	16	108,3	41,6	76	164,3	63,1	36	220,3	84,6	96	276,3	106,1
57	53,2	20,4	17	109,3	41,9	77	165,3	63,4	37	221,2	84,9	97	277,3	106,4
58	54,1	20,8	18	110,2	42,3	78	166,2	63,8	38	222,2	85,3	98	278,2	106,8
59	55,1	21,1	19	111,1	42,6	79	167,1	64,2	39	223,1	85,7	99	279,1	107,2
60	56,0	21,5	20	112,1	43,0	80	168,1	64,5	40	224,1	86,0	300	280,1	107,5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 60 Deg.

Difference of Latitude and Departure for 22 Deg.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00,9	00,4	61	56,5	22,9	121	112,2	45,3	181	167,5	67,8	241	223,5	90,3
2	01,9	00,7	62	57,5	23,2	22	113,1	45,7	82	168,8	68,2	42	224,4	90,7
3	02,8	01,1	63	58,4	23,6	23	114,0	46,1	83	169,7	68,6	43	225,3	91,0
4	03,7	01,5	64	59,3	24,0	24	115,0	46,5	84	170,6	68,9	44	226,2	91,4
5	04,6	01,9	65	60,3	24,3	25	115,9	46,8	85	171,5	69,3	45	227,2	91,8
6	05,6	02,2	66	61,2	24,7	26	116,8	47,2	86	172,4	69,7	46	228,1	92,2
7	06,5	02,6	67	62,1	25,1	27	117,8	47,6	87	173,4	70,1	47	229,0	92,5
8	07,4	03,0	68	63,0	25,5	28	118,7	47,9	88	174,3	70,4	48	229,9	92,9
9	08,3	03,4	69	64,0	25,8	29	119,6	48,3	89	175,2	70,8	49	230,9	93,3
10	09,3	03,7	70	64,9	26,2	30	120,5	48,7	90	176,2	71,2	50	231,8	93,7
11	10,2	04,1	71	65,8	26,6	131	121,5	49,1	191	177,1	71,5	251	232,7	94,0
12	11,1	04,5	72	66,8	27,0	32	122,4	49,4	92	178,0	71,9	52	233,7	94,4
13	12,1	04,9	73	67,7	27,3	33	123,3	49,9	93	178,9	72,3	53	234,6	94,8
14	13,0	05,2	74	68,6	27,7	34	124,2	50,2	94	179,8	72,7	54	235,5	95,2
15	13,9	05,6	75	69,5	28,1	35	125,2	50,6	95	180,8	73,0	55	236,4	95,5
16	14,8	06,0	76	70,5	28,5	36	126,1	50,9	96	181,7	73,4	56	237,4	95,9
17	15,8	06,4	77	71,4	28,8	37	127,0	51,3	97	182,7	73,8	57	238,3	96,3
18	16,7	06,7	78	72,3	29,2	38	128,0	51,7	98	183,6	74,2	58	239,2	96,6
19	17,6	07,1	79	73,2	29,6	39	128,9	52,1	99	184,5	74,5	59	240,1	97,0
20	18,5	7,5	80	74,2	30,0	40	129,8	52,4	200	185,4	74,9	60	241,1	97,4
21	19,5	07,9	81	75,1	30,3	141	130,7	52,8	201	186,4	75,3	261	242,0	97,8
22	20,4	08,2	82	76,0	30,7	42	131,7	53,2	02	187,3	75,7	62	242,9	98,1
23	21,3	08,6	83	77,0	31,1	43	132,6	53,6	03	188,2	76,0	63	243,9	98,5
24	22,3	09,4	84	77,9	31,5	44	133,5	53,9	04	189,1	76,4	64	244,8	98,9
25	23,2	09,0	85	78,8	31,8	45	134,4	54,3	05	190,1	76,8	65	245,7	99,3
26	24,1	09,7	86	79,7	32,2	46	135,4	54,7	06	191,0	77,2	66	246,6	99,6
27	25,0	10,1	87	80,7	32,6	47	136,3	55,1	07	191,9	77,5	67	247,6	100,0
28	26,0	10,5	88	81,6	33,0	48	137,2	55,4	08	192,9	77,9	68	248,5	100,4
29	26,9	10,9	89	82,5	33,3	49	138,2	55,8	09	193,8	78,3	69	249,4	100,8
30	27,8	11,2	90	83,4	33,7	50	139,1	56,2	10	194,7	78,7	70	250,3	101,1
31	28,7	11,6	91	84,2	34,1	151	140,0	56,6	211	195,6	79,0	271	251,3	101,5
32	29,7	12,0	92	85,3	34,5	52	140,9	56,9	12	196,6	79,4	72	252,2	101,9
33	30,6	12,4	93	86,2	34,9	53	141,9	57,3	13	197,5	79,8	73	253,1	102,3
34	31,5	12,7	94	87,2	35,2	54	142,8	57,7	14	198,4	80,2	74	254,1	102,6
35	32,5	13,1	95	88,1	35,6	55	143,7	58,1	15	199,3	80,5	75	255,0	103,0
36	33,4	13,5	96	89,0	36,0	56	144,6	58,4	16	200,3	80,9	76	255,9	103,4
37	34,3	13,9	97	89,9	36,3	57	145,6	58,8	17	201,2	81,3	77	256,8	103,8
38	35,2	14,2	98	90,9	36,7	58	146,5	59,2	18	202,1	81,7	78	257,8	104,1
39	36,2	14,6	99	91,8	37,1	59	147,4	59,6	19	203,1	82,0	79	258,7	104,5
40	37,1	15,0	100	92,7	37,5	60	148,4	59,9	20	204,0	82,4	80	259,6	104,9
41	38,0	15,4	101	93,6	37,8	161	149,3	60,3	221	204,9	82,8	281	260,5	105,3
42	38,9	15,7	02	94,6	38,2	62	150,2	60,7	22	205,8	83,2	82	261,5	105,6
43	39,9	16,1	03	95,5	38,6	63	151,1	61,1	23	206,7	83,5	83	262,4	106,0
44	40,8	16,5	04	96,4	39,0	64	152,1	61,4	24	207,7	83,9	84	263,3	106,4
45	41,7	16,9	05	97,4	39,5	65	153,0	61,8	25	208,6	84,3	85	264,3	106,8
46	42,7	17,2	06	98,3	39,7	66	153,9	62,2	26	209,5	84,7	86	265,2	107,1
47	43,6	17,6	07	99,2	40,1	67	154,8	62,6	27	210,5	85,0	87	266,1	107,5
48	44,5	18,0	08	100,1	40,5	68	155,8	62,9	28	211,4	85,4	88	267,0	107,9
49	45,4	18,4	09	101,1	40,8	69	156,7	63,3	29	212,3	85,8	89	268,0	108,3
50	46,4	18,7	10	102,0	41,2	70	157,6	63,7	30	213,3	86,2	90	268,9	108,6
51	47,3	19,1	111	102,9	41,6	171	158,6	64,1	231	214,2	86,5	291	269,8	109,0
52	48,2	19,5	12	103,8	42,0	72	159,5	64,4	32	215,1	86,9	92	270,7	109,4
53	49,1	19,9	13	104,8	42,5	73	160,4	64,8	33	216,0	87,3	93	271,7	109,8
54	50,1	20,2	14	105,7	42,7	74	161,3	65,2	34	217,0	87,7	94	272,6	110,1
55	51,0	20,6	15	106,6	43,1	75	162,3	65,6	35	217,9	88,0	95	273,5	110,5
56	51,9	21,0	16	107,6	43,5	76	163,2	65,9	36	218,8	88,4	96	274,5	110,9
57	52,9	21,4	17	108,5	43,8	77	164,1	66,3	37	219,7	88,8	97	275,4	111,3
58	53,8	21,7	18	109,4	44,2	78	165,0	66,7	38	220,7	89,2	98	276,3	111,6
59	54,7	22,1	19	110,3	44,6	79	166,0	67,1	39	221,6	89,5	99	277,2	112,0
60	55,6	22,5	20	111,3	45,0	80	166,9	67,4	40	222,5	89,9	300	278,2	112,4
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	D.p.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 62 Deg.

Difference of Latitude and Departure for 23 Deg.

Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.
1	00,9	00,4	61	56,1	23,8	121	111,4	47,3	181	166,6	70,7	241	221,8	94,2
2	01,8	00,8	62	57,1	24,2	22	112,3	47,7	82	167,5	71,1	42	222,8	94,5
3	02,8	01,2	63	58,0	24,6	23	113,2	48,1	83	168,5	71,5	43	223,7	94,9
4	03,7	01,6	64	58,9	25,0	24	114,1	48,4	84	169,4	71,9	44	224,6	95,3
5	04,6	02,0	65	59,8	25,4	25	115,1	48,8	85	170,3	72,3	45	225,5	95,7
6	05,5	02,3	66	60,8	25,8	26	116,0	49,2	86	171,2	72,7	46	226,4	96,1
7	06,4	02,7	67	61,7	26,2	27	116,9	49,6	87	172,1	73,1	47	227,4	96,5
8	07,4	03,1	68	62,6	26,6	28	117,8	50,0	88	173,1	73,5	48	228,3	96,9
9	08,3	03,5	69	63,5	27,0	29	118,7	50,4	89	174,0	73,8	49	229,2	97,3
10	09,2	03,9	70	64,4	27,3	30	119,7	50,8	90	174,9	74,2	50	230,1	97,7
11	10,1	04,3	71	65,4	27,7	31	120,6	51,2	91	175,8	74,6	51	231,0	98,1
12	11,0	04,7	72	66,3	28,1	32	121,5	51,6	92	176,7	75,0	52	232,0	98,5
13	11,0	05,1	73	67,2	28,5	33	122,4	52,0	93	177,7	75,4	53	232,9	98,8
14	12,9	05,5	74	68,1	28,9	34	123,3	52,4	94	178,6	75,8	54	233,8	99,2
15	13,8	05,9	75	69,0	29,3	35	124,3	52,7	95	179,5	76,2	55	234,7	99,6
16	14,7	06,3	76	70,0	29,7	36	125,2	53,1	96	180,4	76,6	56	235,6	100,0
17	15,6	06,6	77	70,9	30,1	37	126,1	53,5	97	181,3	77,0	57	236,6	100,4
18	16,6	07,0	78	71,8	30,5	38	127,0	53,9	98	182,3	77,4	58	237,5	100,8
19	17,5	07,4	79	72,7	30,9	39	127,9	54,3	99	183,2	77,7	59	238,4	101,2
20	18,4	07,8	80	73,6	31,3	40	128,9	54,7	200	184,1	78,1	60	239,3	101,6
21	19,3	08,2	81	74,6	31,6	41	129,8	55,1	201	185,0	78,5	261	240,2	102,0
22	20,3	08,6	82	75,5	32,0	42	130,7	55,5	02	185,9	78,9	62	241,2	102,4
23	21,2	09,0	83	76,4	32,4	43	131,6	55,9	03	186,9	79,3	63	242,1	102,8
24	22,1	09,4	84	77,3	32,8	44	132,6	56,3	04	187,8	79,7	64	243,0	103,1
25	23,0	09,8	85	78,2	33,2	45	133,5	56,7	05	188,7	80,1	65	243,9	103,5
26	23,9	10,2	86	79,2	33,6	46	134,4	57,0	06	189,6	80,5	66	244,9	103,9
27	24,9	10,5	87	80,1	34,0	47	135,3	57,4	07	190,5	80,9	67	245,8	104,3
28	25,8	10,9	88	81,0	34,4	48	136,2	57,8	08	191,5	81,3	68	246,7	104,7
29	26,7	11,3	89	81,9	34,8	49	137,2	58,2	09	192,4	81,7	69	247,6	105,1
30	27,6	11,7	90	82,8	35,2	50	138,1	58,6	10	193,3	82,0	70	248,5	105,5
31	28,5	12,1	91	83,8	35,6	51	139,0	59,0	211	194,2	82,4	271	249,5	105,9
32	29,5	12,5	92	84,7	35,9	52	139,9	59,4	12	195,1	82,8	72	250,4	106,3
33	30,4	12,9	93	85,6	36,3	53	140,8	59,8	13	196,1	83,2	73	251,3	106,7
34	31,3	13,3	94	86,5	36,7	54	141,8	60,2	14	197,0	83,6	74	252,2	107,1
35	32,2	13,7	95	87,4	37,1	55	142,7	60,6	15	197,9	84,0	75	253,1	107,4
36	33,1	14,1	96	88,4	37,5	56	143,6	60,9	16	198,8	84,4	76	254,1	107,8
37	34,1	14,5	97	89,3	37,9	57	144,5	61,3	17	199,7	84,8	77	255,0	108,2
38	35,0	14,8	98	90,2	38,3	58	145,4	61,7	18	200,7	85,2	78	255,9	108,6
39	35,9	15,2	99	91,1	38,7	59	146,4	62,1	19	201,6	85,6	79	256,8	109,0
40	36,8	15,6	100	92,0	39,1	60	147,3	62,5	20	202,5	86,0	80	257,7	109,4
41	37,7	16,0	101	93,0	39,5	61	148,2	62,9	221	203,4	86,3	281	258,7	109,8
42	38,7	16,4	02	93,9	39,9	62	149,1	63,3	22	204,4	86,7	82	259,6	110,2
43	39,6	16,8	03	94,8	40,2	63	150,0	63,7	23	205,3	87,1	83	260,5	110,6
44	40,5	17,2	04	95,7	40,6	64	151,0	64,1	24	206,2	87,5	84	261,4	111,0
45	41,4	17,6	05	96,7	41,0	65	151,9	64,5	25	207,1	87,9	85	262,3	111,3
46	42,3	18,0	06	97,6	41,4	66	152,8	64,9	26	208,0	88,3	86	263,3	111,7
47	43,3	18,4	07	98,5	41,8	67	153,7	65,2	27	209,0	88,7	87	264,2	112,1
48	44,2	18,8	08	99,4	42,2	68	154,6	65,6	28	209,9	89,1	88	265,1	112,5
49	45,1	19,1	09	100,3	42,6	69	155,6	66,0	29	210,8	89,5	89	266,0	112,9
50	46,0	19,5	10	101,3	43,0	70	156,5	66,4	30	211,7	89,9	290	266,9	113,3
51	46,9	19,9	111	102,2	43,4	171	157,4	66,8	231	212,6	90,3	291	267,9	113,7
52	47,9	20,3	12	103,1	43,8	72	158,3	67,2	32	213,6	90,6	92	268,8	114,1
53	48,8	20,7	13	104,0	44,1	73	159,2	67,6	33	214,5	91,0	93	269,7	114,5
54	49,7	21,1	14	104,9	44,5	74	160,2	68,0	34	215,4	91,4	94	270,6	114,9
55	50,6	21,5	15	105,9	44,9	75	161,1	68,4	35	216,3	91,8	95	271,5	115,3
56	51,5	21,9	16	106,8	45,3	76	162,0	68,8	36	217,2	92,2	96	272,5	115,6
57	52,5	22,3	17	107,7	45,7	77	162,9	69,2	37	218,2	92,6	97	273,4	116,0
58	53,4	22,7	18	108,6	46,1	78	163,8	69,5	38	219,1	93,0	98	274,3	116,4
59	54,3	23,1	19	109,5	46,5	79	164,8	69,9	39	220,0	93,4	99	275,2	116,8
60	55,2	23,4	20	110,5	46,9	80	165,7	70,3	40	220,9	93,8	300	276,2	117,2
Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.

Difference of Latitude and Departure for 24 Deg.

Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.
1	00,0	00,4	61	55,7	24,8	121	110,5	49,2	181	165,3	73,6	241	220,2	98,0
2	01,8	00,8	62	56,6	25,2	22	111,4	49,6	82	166,3	74,0	42	221,1	98,4
3	02,7	01,2	63	57,6	25,6	23	112,4	50,0	83	167,2	74,4	43	222,0	98,8
4	03,7	01,6	64	58,5	26,0	24	113,3	50,4	84	168,1	74,8	44	222,9	99,2
5	04,6	02,0	65	59,4	26,4	25	114,2	50,8	85	169,0	75,2	45	223,8	99,6
6	05,5	02,4	66	60,3	26,8	26	115,1	51,2	86	169,9	75,6	46	224,7	100,0
7	06,4	02,8	67	61,2	27,2	27	116,0	51,7	87	170,8	76,1	47	225,6	100,5
8	07,3	03,3	68	62,1	27,7	28	116,9	52,1	88	171,7	76,5	48	226,5	100,9
9	08,2	03,7	69	63,0	28,1	29	117,8	52,5	89	172,7	76,9	49	227,5	101,3
10	09,1	04,1	70	63,9	28,5	30	118,8	52,9	90	173,6	77,3	50	228,4	101,7
11	10,0	04,5	71	64,9	28,9	131	119,7	53,3	191	174,5	77,7	251	229,3	102,1
12	11,0	04,9	72	65,8	29,3	32	120,6	53,7	92	175,4	78,1	52	230,2	102,5
13	11,9	05,3	73	66,7	29,7	33	121,5	54,1	93	176,3	78,5	53	231,2	102,9
14	12,8	05,7	74	67,6	30,1	34	122,4	54,5	94	177,2	78,9	54	232,0	103,3
15	13,7	06,1	75	68,5	30,5	35	123,3	54,9	95	178,1	79,3	55	232,9	103,7
16	14,6	06,5	76	69,4	30,9	36	124,2	55,3	96	179,0	79,7	56	233,8	104,1
17	15,5	06,9	77	70,3	31,3	37	125,1	55,7	97	180,0	80,1	57	234,6	104,5
18	16,4	07,3	78	71,3	31,7	38	126,1	56,1	98	180,8	80,5	58	235,5	104,9
19	17,4	07,7	79	72,2	32,1	39	127,0	56,5	99	181,7	80,9	59	236,6	105,3
20	18,3	08,1	80	73,1	32,5	40	127,9	56,9	200	182,7	81,3	60	237,5	105,7
21	19,2	08,5	81	74,0	32,9	141	128,8	57,3	201	183,6	81,7	261	238,4	106,1
22	20,1	08,9	82	74,9	33,3	42	129,7	57,8	02	184,5	82,2	62	239,3	106,6
23	21,0	09,4	83	75,8	33,8	43	130,6	58,2	03	185,4	82,6	63	240,3	107,0
24	21,9	09,8	84	76,7	34,2	44	131,5	58,6	04	186,4	83,0	64	241,2	107,4
25	22,8	10,2	85	77,6	34,6	45	132,5	59,0	05	187,3	83,4	65	242,1	107,8
26	23,8	10,6	86	78,6	35,0	46	133,4	59,4	06	188,2	83,8	66	243,0	108,2
27	24,7	11,0	87	79,5	35,4	47	134,3	59,8	07	189,1	84,2	67	243,9	108,6
28	25,6	11,4	88	80,4	35,8	48	135,2	60,2	08	190,0	84,6	68	244,8	109,0
29	26,5	11,8	89	81,3	36,2	49	136,1	60,6	09	190,9	85,0	69	245,7	109,4
30	27,4	12,2	90	82,2	36,6	50	137,0	61,0	10	191,8	85,4	70	245,6	109,8
31	28,3	12,6	91	83,1	37,0	151	137,9	61,4	211	192,7	85,8	271	245,6	110,2
32	29,2	13,0	92	84,0	37,4	52	138,9	61,8	12	193,7	86,2	72	248,5	110,6
33	30,1	13,4	93	85,0	37,8	53	139,8	62,2	13	194,6	86,6	73	249,4	111,0
34	31,1	13,8	94	85,9	38,2	54	140,7	62,6	14	195,5	87,0	74	250,3	111,4
35	32,0	14,2	95	86,8	38,6	55	141,6	63,0	15	196,4	87,4	75	251,2	111,8
36	32,9	14,6	96	87,7	39,0	56	142,5	63,4	16	197,3	87,8	76	252,1	112,2
37	33,8	15,0	97	88,6	39,4	57	143,4	63,9	17	198,2	88,3	77	253,0	112,7
38	34,7	15,5	98	89,5	39,9	58	144,3	64,3	18	199,1	88,7	78	254,0	113,1
39	35,6	15,9	99	90,4	40,3	59	145,2	64,7	19	200,1	89,1	79	254,9	113,5
40	36,5	16,3	100	91,4	40,7	60	146,2	65,1	20	201,0	89,5	80	255,8	113,9
41	37,5	16,7	101	92,3	41,1	161	147,1	65,5	221	201,9	89,9	281	256,7	114,3
42	38,4	17,1	02	93,2	41,5	62	148,0	65,9	22	202,8	90,3	82	257,6	114,7
43	39,3	17,5	03	94,1	41,9	63	148,9	66,3	23	203,7	90,7	83	258,5	115,1
44	40,2	17,9	04	95,0	42,3	64	149,8	66,7	24	204,6	91,1	84	259,4	115,5
45	41,1	18,3	05	95,9	42,7	65	150,7	67,1	25	205,5	91,5	85	260,3	115,9
46	42,0	18,7	06	96,8	43,1	66	151,6	67,5	26	206,5	91,9	86	261,3	116,3
47	42,9	19,1	07	97,7	43,5	67	152,6	67,9	27	207,4	92,3	87	262,2	116,7
48	43,8	19,5	08	98,7	43,9	68	153,5	68,3	28	208,3	92,7	88	263,1	117,1
49	44,8	19,9	09	99,6	44,3	69	154,4	68,7	29	209,2	93,1	89	264,0	117,5
50	45,7	20,3	10	100,5	44,7	70	155,3	69,1	30	210,1	93,5	90	264,9	117,9
51	46,6	20,7	111	101,4	45,1	171	156,2	69,5	231	211,0	93,9	291	265,8	118,3
52	47,5	21,1	12	102,3	45,6	72	157,1	70,0	32	211,9	94,4	92	266,7	118,8
53	48,4	21,6	13	103,2	46,0	73	158,0	70,4	33	212,8	94,8	93	267,7	119,2
54	49,3	22,0	14	104,1	46,4	74	158,9	70,8	34	213,8	95,2	94	268,6	119,6
55	50,2	22,4	15	105,1	46,8	75	159,9	71,2	35	214,7	95,6	95	269,5	120,0
56	51,2	22,8	16	106,0	47,2	76	160,8	71,6	36	215,6	96,0	96	270,4	120,4
57	52,1	23,2	17	106,9	47,6	77	161,7	72,0	37	216,5	96,4	97	271,3	120,8
58	53,0	23,6	18	107,8	48,0	78	162,6	72,4	38	217,4	96,8	98	272,2	121,2
59	53,9	24,0	19	108,7	48,4	79	163,5	72,8	39	218,3	97,2	99	273,1	121,6
60	54,8	24,4	20	109,6	48,8	80	164,4	73,2	40	219,2	97,6	100	274,1	122,0
Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.

for 66 Deg.

Difference of Latitude and Departure for 25 Deg.

Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.
1	00,9	00,4	61	55,3	25,8	121	109,7	51,1	181	164,0	76,5	241	218,4	101,8
2	01,8	00,8	62	56,2	26,2	22	110,6	51,6	82	164,9	76,9	42	219,3	102,3
3	02,7	01,3	63	57,1	26,6	23	111,5	52,0	83	165,9	77,3	43	220,2	102,7
4	03,6	01,7	64	58,0	27,0	24	112,4	52,4	84	166,8	77,8	44	221,1	103,1
5	04,5	02,1	65	58,9	27,5	25	113,3	52,8	85	167,7	78,2	45	222,0	103,5
6	05,4	02,5	66	59,8	27,9	26	114,2	53,2	86	168,6	78,6	46	222,9	104,0
7	06,3	03,0	67	60,7	28,3	27	115,1	53,7	87	169,5	79,0	47	223,9	104,4
8	07,3	03,4	68	61,6	28,7	28	116,0	54,1	88	170,4	79,4	48	224,8	104,8
9	08,2	03,8	69	62,5	29,2	29	116,9	54,5	89	171,3	79,9	49	225,7	105,2
10	09,1	04,2	70	63,4	29,6	30	117,8	54,9	90	172,2	80,3	50	226,6	105,7
11	10,0	04,6	71	64,3	30,0	131	118,7	55,4	191	173,1	80,7	251	227,5	106,1
12	10,9	05,0	72	65,3	30,4	32	119,6	55,8	92	174,0	81,1	52	228,4	106,5
13	11,8	05,5	73	66,2	30,8	33	120,5	56,2	93	174,9	81,6	53	229,3	106,9
14	12,7	05,9	74	67,1	31,3	34	121,4	56,6	94	175,8	82,0	54	230,2	107,3
15	13,6	06,3	75	68,0	31,7	35	122,4	57,1	95	176,7	82,4	55	231,1	107,8
16	14,5	06,8	76	68,9	32,1	36	123,3	57,5	96	177,6	82,8	56	232,0	108,2
17	15,4	07,2	77	69,8	32,5	37	124,2	57,9	97	178,5	83,3	57	232,9	108,6
18	16,3	07,6	78	70,7	33,0	38	125,1	58,3	98	179,4	83,7	58	233,8	109,0
19	17,2	08,0	79	71,6	33,4	39	126,0	58,7	99	180,4	84,1	59	234,7	109,5
20	18,1	08,5	80	72,5	33,8	40	126,9	59,2	100	181,3	84,5	60	235,6	109,9
21	19,0	08,9	81	73,4	34,2	141	127,8	59,6	201	182,2	84,9	261	236,5	110,3
22	19,9	09,3	82	74,3	34,7	42	128,7	60,0	02	183,1	85,4	62	237,5	110,7
23	20,8	09,7	83	75,2	35,1	43	129,6	60,4	03	184,0	85,8	63	238,4	111,1
24	21,8	10,1	84	76,1	35,5	44	130,5	60,9	04	184,9	86,2	64	239,3	111,6
25	22,7	10,6	85	77,0	35,9	45	131,4	61,3	05	185,8	86,6	65	240,2	112,0
26	23,6	11,0	86	77,9	36,3	46	132,3	61,7	06	186,7	87,1	66	241,1	112,4
27	24,5	11,4	87	78,8	36,8	47	133,2	62,1	07	187,6	87,5	67	242,0	112,8
28	25,4	11,8	88	79,8	37,2	48	134,1	62,5	08	188,5	87,9	68	242,9	113,3
29	26,3	12,3	89	80,7	37,6	49	135,0	63,0	09	189,4	88,3	69	243,8	113,7
30	27,2	12,7	90	81,6	38,0	50	135,9	63,4	10	190,3	88,7	70	244,7	114,1
31	28,1	13,1	91	82,5	38,5	151	136,9	63,8	211	191,2	89,2	271	245,6	114,5
32	29,0	13,5	92	83,4	38,9	52	137,8	64,2	12	192,1	89,6	72	246,5	114,9
33	29,9	13,9	93	84,3	39,3	53	138,7	64,7	13	193,0	90,0	73	247,4	115,4
34	30,8	14,4	94	85,2	39,7	54	139,6	65,1	14	193,9	90,4	74	248,3	115,8
35	31,7	14,8	95	86,1	40,1	55	140,5	65,5	15	194,9	90,9	75	249,2	116,2
36	32,6	15,2	96	87,0	40,6	56	141,4	65,9	16	195,8	91,3	76	250,1	116,6
37	33,5	15,6	97	87,9	41,0	57	142,3	66,3	17	196,7	91,7	77	251,0	117,1
38	34,4	16,1	98	88,8	41,4	58	143,2	66,8	18	197,6	92,1	78	252,0	117,5
39	35,3	16,5	99	89,7	41,8	59	144,1	67,2	19	198,5	92,5	79	252,9	117,9
40	36,3	16,9	100	90,6	42,3	60	145,0	67,6	20	199,4	93,0	80	253,8	118,3
41	37,2	17,3	101	91,5	42,7	161	145,9	68,0	221	200,3	93,4	281	254,7	118,8
42	38,1	17,7	02	92,4	43,1	62	146,8	68,5	22	201,2	93,8	82	255,6	119,2
43	39,0	18,2	03	93,3	43,5	63	147,7	68,9	23	202,1	94,2	83	256,5	119,6
44	39,9	18,6	04	94,3	44,0	64	148,6	69,3	24	203,0	94,7	84	257,4	120,0
45	40,8	19,0	05	95,2	44,4	65	149,5	69,7	25	203,9	95,1	85	258,3	120,4
46	41,7	19,4	06	96,1	44,8	66	150,4	70,2	26	204,8	95,5	86	259,2	120,9
47	42,6	19,9	07	97,0	45,2	67	151,4	70,6	27	205,7	95,9	87	260,1	121,3
48	43,5	20,3	08	97,9	45,6	68	152,3	71,0	28	206,6	96,4	88	261,0	121,7
49	44,4	20,7	09	98,8	46,1	69	153,2	71,4	29	207,5	96,8	89	261,9	122,1
50	45,3	21,1	10	99,7	46,5	70	154,1	71,8	30	208,4	97,2	90	262,8	122,6
51	46,2	21,6	111	100,6	46,9	171	155,0	72,3	231	209,4	97,6	291	263,7	123,0
52	47,1	22,0	12	101,5	47,3	72	155,9	72,7	32	210,3	98,0	92	264,6	123,4
53	48,0	22,4	13	102,4	47,8	73	156,8	73,1	33	211,2	98,5	93	265,5	123,8
54	48,9	22,8	14	103,3	48,2	74	157,7	73,5	34	212,1	98,9	94	266,5	124,2
55	49,8	23,2	15	104,2	48,6	75	158,6	74,0	35	213,0	99,3	95	267,4	124,7
56	50,8	23,7	16	105,1	49,0	76	159,5	74,4	36	213,9	99,7	96	268,3	125,1
57	51,7	24,1	17	106,0	49,4	77	160,4	74,8	37	214,8	100,2	97	269,2	125,5
58	52,6	24,5	18	106,9	49,9	78	161,3	75,2	38	215,7	100,6	98	270,1	125,9
59	53,5	24,9	19	107,8	50,3	79	162,2	75,6	39	216,6	101,0	99	271,0	126,4
60	54,4	25,4	20	108,8	50,7	80	163,1	76,1	40	217,5	101,4	100	271,9	126,8
Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.

Difference of Latitude and Departure for 25 Deg.

D.A.	Lat.	Dep.	D.A.	Lat.	Dep.	D.A.	Lat.	Dep.	D.A.	Lat.	Dep.	D.A.	Lat.	Dep.
1	00.0	00.0	1	00.0	00.0	1	00.0	00.0	1	00.0	00.0	1	00.0	00.0
2	00.1	00.1	2	00.2	00.2	2	00.3	00.3	2	00.4	00.4	2	00.5	00.5
3	00.2	00.2	3	00.4	00.4	3	00.6	00.6	3	00.8	00.8	3	01.0	01.0
4	00.3	00.3	4	00.6	00.6	4	00.9	00.9	4	01.2	01.2	4	01.5	01.5
5	00.4	00.4	5	00.8	00.8	5	01.2	01.2	5	01.6	01.6	5	02.0	02.0
6	00.5	00.5	6	01.0	01.0	6	01.5	01.5	6	02.0	02.0	6	02.5	02.5
7	00.6	00.6	7	01.2	01.2	7	01.8	01.8	7	02.4	02.4	7	03.0	03.0
8	00.7	00.7	8	01.4	01.4	8	02.0	02.0	8	02.8	02.8	8	03.5	03.5
9	00.8	00.8	9	01.6	01.6	9	02.3	02.3	9	03.2	03.2	9	04.0	04.0
10	00.9	00.9	10	01.8	01.8	10	02.6	02.6	10	03.6	03.6	10	04.5	04.5
11	01.0	01.0	11	02.0	02.0	11	02.9	02.9	11	04.0	04.0	11	05.0	05.0
12	01.1	01.1	12	02.2	02.2	12	03.2	03.2	12	04.4	04.4	12	05.5	05.5
13	01.2	01.2	13	02.4	02.4	13	03.5	03.5	13	04.8	04.8	13	06.0	06.0
14	01.3	01.3	14	02.6	02.6	14	03.8	03.8	14	05.2	05.2	14	06.5	06.5
15	01.4	01.4	15	02.8	02.8	15	04.1	04.1	15	05.6	05.6	15	07.0	07.0
16	01.5	01.5	16	03.0	03.0	16	04.4	04.4	16	06.0	06.0	16	07.5	07.5
17	01.6	01.6	17	03.2	03.2	17	04.7	04.7	17	06.4	06.4	17	08.0	08.0
18	01.7	01.7	18	03.4	03.4	18	05.0	05.0	18	06.8	06.8	18	08.5	08.5
19	01.8	01.8	19	03.6	03.6	19	05.3	05.3	19	07.2	07.2	19	09.0	09.0
20	01.9	01.9	20	03.8	03.8	20	05.6	05.6	20	07.6	07.6	20	09.5	09.5
21	02.0	02.0	21	04.0	04.0	21	05.9	05.9	21	08.0	08.0	21	10.0	10.0
22	02.1	02.1	22	04.2	04.2	22	06.2	06.2	22	08.4	08.4	22	10.5	10.5
23	02.2	02.2	23	04.4	04.4	23	06.5	06.5	23	08.8	08.8	23	11.0	11.0
24	02.3	02.3	24	04.6	04.6	24	06.8	06.8	24	09.2	09.2	24	11.5	11.5
25	02.4	02.4	25	04.8	04.8	25	07.1	07.1	25	09.6	09.6	25	12.0	12.0
26	02.5	02.5	26	05.0	05.0	26	07.4	07.4	26	10.0	10.0	26	12.5	12.5
27	02.6	02.6	27	05.2	05.2	27	07.7	07.7	27	10.4	10.4	27	13.0	13.0
28	02.7	02.7	28	05.4	05.4	28	08.0	08.0	28	10.8	10.8	28	13.5	13.5
29	02.8	02.8	29	05.6	05.6	29	08.3	08.3	29	11.2	11.2	29	14.0	14.0
30	02.9	02.9	30	05.8	05.8	30	08.6	08.6	30	11.6	11.6	30	14.5	14.5
31	03.0	03.0	31	06.0	06.0	31	08.9	08.9	31	12.0	12.0	31	15.0	15.0
32	03.1	03.1	32	06.2	06.2	32	09.2	09.2	32	12.4	12.4	32	15.5	15.5
33	03.2	03.2	33	06.4	06.4	33	09.5	09.5	33	12.8	12.8	33	16.0	16.0
34	03.3	03.3	34	06.6	06.6	34	09.8	09.8	34	13.2	13.2	34	16.5	16.5
35	03.4	03.4	35	06.8	06.8	35	10.1	10.1	35	13.6	13.6	35	17.0	17.0
36	03.5	03.5	36	07.0	07.0	36	10.4	10.4	36	14.0	14.0	36	17.5	17.5
37	03.6	03.6	37	07.2	07.2	37	10.7	10.7	37	14.4	14.4	37	18.0	18.0
38	03.7	03.7	38	07.4	07.4	38	11.0	11.0	38	14.8	14.8	38	18.5	18.5
39	03.8	03.8	39	07.6	07.6	39	11.3	11.3	39	15.2	15.2	39	19.0	19.0
40	03.9	03.9	40	07.8	07.8	40	11.6	11.6	40	15.6	15.6	40	19.5	19.5
41	04.0	04.0	41	08.0	08.0	41	11.9	11.9	41	16.0	16.0	41	20.0	20.0
42	04.1	04.1	42	08.2	08.2	42	12.2	12.2	42	16.4	16.4	42	20.5	20.5
43	04.2	04.2	43	08.4	08.4	43	12.5	12.5	43	16.8	16.8	43	21.0	21.0
44	04.3	04.3	44	08.6	08.6	44	12.8	12.8	44	17.2	17.2	44	21.5	21.5
45	04.4	04.4	45	08.8	08.8	45	13.1	13.1	45	17.6	17.6	45	22.0	22.0
46	04.5	04.5	46	09.0	09.0	46	13.4	13.4	46	18.0	18.0	46	22.5	22.5
47	04.6	04.6	47	09.2	09.2	47	13.7	13.7	47	18.4	18.4	47	23.0	23.0
48	04.7	04.7	48	09.4	09.4	48	14.0	14.0	48	18.8	18.8	48	23.5	23.5
49	04.8	04.8	49	09.6	09.6	49	14.3	14.3	49	19.2	19.2	49	24.0	24.0
50	04.9	04.9	50	09.8	09.8	50	14.6	14.6	50	19.6	19.6	50	24.5	24.5
51	05.0	05.0	51	10.0	10.0	51	14.9	14.9	51	20.0	20.0	51	25.0	25.0
52	05.1	05.1	52	10.2	10.2	52	15.2	15.2	52	20.4	20.4	52	25.5	25.5
53	05.2	05.2	53	10.4	10.4	53	15.5	15.5	53	20.8	20.8	53	26.0	26.0
54	05.3	05.3	54	10.6	10.6	54	15.8	15.8	54	21.2	21.2	54	26.5	26.5
55	05.4	05.4	55	10.8	10.8	55	16.1	16.1	55	21.6	21.6	55	27.0	27.0
56	05.5	05.5	56	11.0	11.0	56	16.4	16.4	56	22.0	22.0	56	27.5	27.5
57	05.6	05.6	57	11.2	11.2	57	16.7	16.7	57	22.4	22.4	57	28.0	28.0
58	05.7	05.7	58	11.4	11.4	58	17.0	17.0	58	22.8	22.8	58	28.5	28.5
59	05.8	05.8	59	11.6	11.6	59	17.3	17.3	59	23.2	23.2	59	29.0	29.0
60	05.9	05.9	60	11.8	11.8	60	17.6	17.6	60	23.6	23.6	60	29.5	29.5
61	06.0	06.0	61	12.0	12.0	61	17.9	17.9	61	24.0	24.0	61	30.0	30.0
62	06.1	06.1	62	12.2	12.2	62	18.2	18.2	62	24.4	24.4	62	30.5	30.5
63	06.2	06.2	63	12.4	12.4	63	18.5	18.5	63	24.8	24.8	63	31.0	31.0
64	06.3	06.3	64	12.6	12.6	64	18.8	18.8	64	25.2	25.2	64	31.5	31.5
65	06.4	06.4	65	12.8	12.8	65	19.1	19.1	65	25.6	25.6	65	32.0	32.0
66	06.5	06.5	66	13.0	13.0	66	19.4	19.4	66	26.0	26.0	66	32.5	32.5
67	06.6	06.6	67	13.2	13.2	67	19.7	19.7	67	26.4	26.4	67	33.0	33.0
68	06.7	06.7	68	13.4	13.4	68	20.0	20.0	68	26.8	26.8	68	33.5	33.5
69	06.8	06.8	69	13.6	13.6	69	20.3	20.3	69	27.2	27.2	69	34.0	34.0
70	06.9	06.9	70	13.8	13.8	70	20.6	20.6	70	27.6	27.6	70	34.5	34.5
71	07.0	07.0	71	14.0	14.0	71	20.9	20.9	71	28.0	28.0	71	35.0	35.0
72	07.1	07.1	72	14.2	14.2	72	21.2	21.2	72	28.4	28.4	72	35.5	35.5
73	07.2	07.2	73	14.4	14.4	73	21.5	21.5	73	28.8	28.8	73	36.0	36.0
74	07.3	07.3	74	14.6	14.6	74	21.8	21.8	74	29.2	29.2	74	36.5	36.5
75	07.4	07.4	75	14.8	14.8	75	22.1	22.1	75	29.6	29.6	75	37.0	37.0
76	07.5	07.5	76	15.0	15.0	76	22.4	22.4	76	30.0	30.0	76	37.5	37.5
77	07.6	07.6	77	15.2	15.2	77	22.7	22.7	77	30.4	30.4	77	38.0	38.0
78	07.7	07.7	78	15.4	15.4	78	23.0	23.0	78	30.8	30.8	78	38.5	38.5
79	07.8	07.8	79	15.6	15.6	79	23.3	23.3	79	31.2	31.2	79	39.0	39.0
80	07.9	07.9	80	15.8	15.8	80	23.6	23.6	80	31.6	31.6	80	39.5	39.5
81	08.0	08.0	81	16.0	16.0	81	23.9	23.9	81	32.0	32.0	81	40.0	40.0
82	08.1	08.1	82	16.2	16.2	82	24.2	24.2	82	32.4	32.4	82	40.5	40.5
83	08.2	08.2	83	16.4	16.4	83	24.5	24.5	83	32.8	32.8	83	41.0	41.0
84	08.3	08.3	84	16.6	16.6	84	24.8	24.8	84	33.2	33.2	84	41.5	41.5
85	08.4	08.4	85	16.8	16.8	85	25.1	25.1	85	33.6	33.6	85	42.0	42.0
86	08.5	08.5	86	17.0	17.0	86	25.4	25.4	86	34.0	34.0	86	42.5	42.5
87	08.6	08.6	87	17.2	17.2	87	25.7	25.7	87	34.4	34.4	87	43.0	43.0
88	08.7	08.7	88	17.4	17.4	88	26.0	26.0	88	34.8	34.8	88	43.5	43.5
89	08.8	08.8	89	17.6	17.6	89	26.3	26.3	89	35.2	35.2	89	44.0	44.0
90	08.9	08.9	90	17.8	17.8	90	26.6	26.6	90	35.6	35.6	90	44.5	44.5
91	09.0	09.0	91	18.0	18.0	91	26.9	26.9	91	36.0	36.0	91	45.0	45.0
92	09.1	09.1	92	18.2	18.2	92	27.2	27.2	92	36.4	36.4	92	45.5	45.5
93	09.2	09.2	93	18.4	18.4	93	27.5	27.5	93	36.8	36.8	93	46.0	46.0
94	09.3	09.3	94	18.6	18.6	94	27.8	27.8	94	37.2	37.2	94	46.5	46.5
95	09.4	09.4	95											

Difference of Latitude and Departure for 27 Deg.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00,9	00,5	61	54,4	27,7	121	107,3	54,9	181	161,3	82,2	241	214,7	109,4
2	01,8	00,9	62	55,2	28,1	22	108,7	55,4	82	162,2	82,6	42	215,6	109,9
3	02,7	01,4	63	56,1	28,6	23	109,6	55,8	83	163,1	83,1	43	216,5	110,3
4	03,6	01,8	64	57,0	29,1	24	110,5	56,3	84	163,9	83,5	44	217,4	110,8
5	04,5	02,3	65	57,9	29,5	25	111,4	56,8	85	164,8	84,0	45	218,3	111,2
6	05,3	02,7	66	58,8	30,0	26	112,3	57,2	86	165,7	84,4	46	219,2	111,7
7	06,2	03,2	67	59,7	30,4	27	113,2	57,7	87	166,6	84,9	47	220,1	112,1
8	07,1	03,6	68	60,6	30,9	28	114,0	58,1	88	167,5	85,4	48	221,0	112,6
9	08,0	04,1	69	61,5	31,3	29	114,9	58,6	89	168,4	85,8	49	221,9	113,0
10	08,9	04,5	70	62,4	31,8	30	115,8	59,0	90	169,3	86,3	50	222,8	113,5
11	09,8	05,0	71	63,3	32,2	31	116,7	59,5	91	170,2	86,7	51	223,6	114,0
12	10,7	05,4	72	64,2	32,7	32	117,6	59,9	92	171,1	87,2	52	224,5	114,4
13	11,6	05,9	73	65,0	33,1	33	118,5	60,4	93	172,0	87,6	53	225,4	114,9
14	12,5	06,4	74	65,9	33,6	34	119,4	60,8	94	172,9	88,1	54	226,3	115,3
15	13,4	06,8	75	66,8	34,1	35	120,3	61,3	95	173,7	88,5	55	227,2	115,8
16	14,3	07,3	76	67,7	34,5	36	121,2	61,7	96	174,6	89,0	56	228,1	116,2
17	15,1	07,7	77	68,6	35,0	37	122,1	62,2	97	175,5	89,4	57	229,0	116,7
18	16,0	08,2	78	69,5	35,4	38	123,0	62,7	98	176,4	89,9	58	229,9	117,1
19	16,9	08,6	79	70,4	35,9	39	123,8	63,1	99	177,3	90,3	59	230,8	117,6
20	17,8	09,1	80	71,3	36,3	40	124,7	63,6	200	178,2	90,8	60	231,7	118,0
21	18,7	09,5	81	72,2	36,8	41	125,6	64,0	201	179,1	91,3	61	232,6	118,5
22	19,6	10,0	82	73,1	37,2	42	126,5	64,5	02	180,0	91,7	62	233,4	118,9
23	20,5	10,4	83	74,0	37,7	43	127,4	64,9	03	180,9	92,2	63	234,3	119,4
24	21,4	10,9	84	74,8	38,1	44	128,3	65,4	04	181,8	92,6	64	235,2	119,9
25	22,3	11,4	85	75,7	38,6	45	129,2	65,8	05	182,7	93,1	65	236,1	120,3
26	23,2	11,8	86	76,6	39,0	46	130,1	66,3	06	183,5	93,5	66	237,0	120,8
27	24,1	12,3	87	77,5	39,5	47	131,0	66,7	07	184,4	94,0	67	237,9	121,2
28	24,9	12,7	88	78,4	40,0	48	131,9	67,2	08	185,3	94,4	68	238,8	121,7
29	25,8	13,2	89	79,3	40,4	49	132,8	67,6	09	186,2	94,9	69	239,7	122,1
30	26,7	13,6	90	80,2	40,9	50	133,7	68,1	10	187,1	95,3	70	240,6	122,6
31	27,6	14,1	91	81,1	41,3	51	134,5	68,6	11	188,0	95,8	71	241,5	123,0
32	28,5	14,5	92	82,0	41,8	52	135,4	69,0	12	188,9	96,2	72	242,4	123,5
33	29,4	15,0	93	82,9	42,2	53	136,3	69,5	13	189,8	96,7	73	243,3	123,9
34	30,3	15,4	94	83,8	42,7	54	137,2	69,9	14	190,7	97,2	74	244,2	124,4
35	31,2	15,9	95	84,6	43,1	55	138,1	70,4	15	191,6	97,6	75	245,1	124,9
36	32,1	16,3	96	85,5	43,6	56	139,0	70,8	16	192,5	98,1	76	246,0	125,3
37	33,0	16,8	97	86,4	44,0	57	139,9	71,3	17	193,3	98,5	77	246,9	125,8
38	33,9	17,3	98	87,3	44,5	58	140,8	71,7	18	194,2	99,0	78	247,8	126,2
39	34,7	17,7	99	88,2	44,9	59	141,7	72,2	19	195,1	99,4	79	248,7	126,7
40	35,6	18,2	100	89,1	45,4	60	142,6	72,6	20	196,0	99,9	80	249,6	127,1
41	36,5	18,6	101	90,0	45,9	61	143,5	73,1	21	196,9	100,4	81	250,5	127,6
42	37,4	19,1	02	90,9	46,3	62	144,3	73,5	22	197,8	100,8	82	251,4	128,0
43	38,3	19,5	03	91,8	46,8	63	145,2	74,0	23	198,7	101,2	83	252,3	128,5
44	39,2	20,0	04	92,7	47,2	64	146,1	74,5	24	199,6	101,7	84	253,2	128,9
45	40,1	20,4	05	93,6	47,7	65	147,0	74,9	25	200,5	102,2	85	254,1	129,4
46	41,0	20,9	06	94,4	48,1	66	147,9	75,4	26	201,4	102,6	86	255,0	129,8
47	41,9	21,3	07	95,3	48,6	67	148,8	75,8	27	202,3	103,1	87	255,9	130,3
48	42,8	21,8	08	96,2	49,0	68	149,7	76,3	28	203,1	103,5	88	256,8	130,8
49	43,7	22,2	09	97,1	49,5	69	150,6	76,7	29	204,0	104,0	89	257,7	131,2
50	44,6	22,7	10	98,0	49,9	70	151,5	77,2	30	204,9	104,4	90	258,6	131,7
51	45,4	23,2	11	98,9	50,4	71	152,4	77,6	31	205,8	104,9	91	259,5	132,1
52	46,3	23,6	12	99,8	50,8	72	153,3	78,1	32	206,7	105,3	92	260,4	132,6
53	47,2	24,1	13	100,7	51,3	73	154,2	78,5	33	207,6	105,8	93	261,3	133,0
54	48,1	24,5	14	101,6	51,8	74	155,0	79,0	34	208,5	106,2	94	262,2	133,5
55	49,0	25,0	15	102,5	52,2	75	155,9	79,5	35	209,4	106,7	95	263,1	133,9
56	49,9	25,4	16	103,4	52,7	76	156,8	79,9	36	210,3	107,1	96	264,0	134,4
57	50,8	25,9	17	104,2	53,1	77	157,7	80,4	37	211,2	107,6	97	264,9	134,8
58	51,7	26,3	18	105,1	53,6	78	158,6	80,8	38	212,1	108,1	98	265,8	135,3
59	52,6	26,8	19	106,0	54,0	79	159,5	81,3	39	213,0	108,5	99	266,7	135,7
60	53,5	27,2	20	106,9	54,5	80	160,4	81,7	40	213,9	109,0	100	267,6	136,2
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

Difference of Latitude and Departure for 28 Deg.

Dift.	Lat.	Dep.	Dift.	Lat.	Dep.	Dift.	Lat.	Dep.	Dift.	Lat.	Dep.	Dift.	Lat.	Dep.
1	00,9	00,5	61	53,9	28,6	121	106,8	56,8	181	159,8	85,0	241	212,8	113,1
2	01,8	00,9	62	54,7	29,1	22	107,7	57,3	82	160,7	85,4	42	213,7	113,6
3	02,6	01,4	63	55,6	29,6	23	108,6	57,7	83	161,6	85,9	43	214,6	114,1
4	03,5	01,9	64	56,5	30,0	24	109,5	58,2	84	162,5	86,4	44	215,5	114,6
5	04,4	02,3	65	57,4	30,5	25	110,4	58,7	85	163,4	86,9	45	216,3	115,0
6	05,3	02,8	66	58,3	31,0	26	111,3	59,2	86	164,2	87,3	46	217,2	115,5
7	06,2	03,3	67	59,2	31,5	27	112,1	59,6	87	165,1	87,8	47	218,1	115,9
8	07,1	03,8	68	60,0	31,9	28	113,0	60,1	88	166,0	88,2	48	219,0	116,4
9	07,9	04,3	69	60,9	32,4	29	113,9	60,6	89	166,9	88,7	49	219,9	116,9
10	08,8	04,7	70	61,8	32,9	30	114,8	61,0	90	167,8	89,2	50	220,8	117,4
11	09,7	05,2	71	62,7	33,3	31	115,7	61,5	191	168,7	89,7	251	221,6	117,8
12	10,5	05,6	72	63,5	33,8	32	116,6	62,0	92	169,5	90,1	52	222,5	118,3
13	11,5	06,1	73	64,5	34,3	33	117,4	62,4	93	170,4	90,6	53	223,4	118,8
14	12,4	06,6	74	65,3	34,7	34	118,3	62,9	94	171,3	91,1	54	224,3	119,2
15	13,2	07,0	75	66,2	35,2	35	119,2	63,4	95	172,2	91,6	55	225,2	119,7
16	14,1	07,5	76	67,1	35,7	36	120,1	63,9	96	173,1	92,0	56	226,0	120,2
17	15,0	08,0	77	68,0	36,2	37	121,0	64,3	97	174,0	92,5	57	226,9	120,7
18	15,9	08,5	78	68,9	36,6	38	121,9	64,8	98	174,8	93,0	58	227,8	121,1
19	16,8	08,9	79	69,8	37,1	39	122,7	65,3	99	175,7	93,4	59	228,7	121,6
20	17,7	09,4	80	70,6	37,6	40	123,6	65,7	200	176,6	93,9	60	229,6	122,1
21	18,5	09,9	81	71,5	38,0	41	124,5	66,2	201	177,5	94,4	261	230,5	122,5
22	19,4	10,3	82	72,4	38,5	42	125,4	66,7	02	178,4	94,8	62	231,3	123,0
23	20,3	10,8	83	73,3	39,0	43	126,3	67,1	03	179,2	95,3	63	232,2	123,5
24	21,2	11,3	84	74,2	39,4	44	127,2	67,6	04	180,1	95,8	64	233,1	123,9
25	22,1	11,7	85	75,1	39,9	45	128,0	68,1	05	181,0	96,2	65	234,0	124,4
26	23,0	12,2	86	75,9	40,4	46	128,9	68,5	06	181,9	96,7	66	234,9	124,9
27	23,8	12,7	87	76,8	40,8	47	129,8	69,0	07	182,8	97,2	67	235,8	125,4
28	24,7	13,1	88	77,7	41,3	48	130,7	69,5	08	183,7	97,7	68	236,6	125,8
29	25,6	13,6	89	78,6	41,8	49	131,6	70,0	09	184,5	98,1	69	237,5	126,3
30	26,5	14,1	90	79,5	42,3	50	132,5	70,4	10	185,4	98,6	70	238,4	126,8
31	27,4	14,6	91	80,4	42,7	151	133,3	70,9	211	186,3	99,1	271	239,3	127,2
32	28,3	15,0	92	81,2	43,2	52	134,2	71,4	12	187,2	99,5	72	240,2	127,7
33	29,1	15,5	93	82,1	43,7	53	135,1	71,8	13	188,1	100,0	73	241,1	128,2
34	30,0	16,0	94	83,0	44,1	54	136,0	72,3	14	189,0	100,5	74	241,9	128,6
35	30,9	16,4	95	83,9	44,6	55	136,9	72,8	15	189,8	100,9	75	242,8	129,1
36	31,8	16,9	96	84,8	45,1	56	137,7	73,2	16	190,7	101,4	76	243,7	129,6
37	32,7	17,4	97	85,7	45,5	57	138,6	73,7	17	191,6	101,9	77	244,6	130,1
38	33,6	17,8	98	86,5	46,0	58	139,5	74,2	18	192,5	102,4	78	245,5	130,5
39	34,4	18,3	99	87,4	46,5	59	140,4	74,6	19	193,4	102,8	79	246,4	131,0
40	35,3	18,8	100	88,3	47,0	60	141,3	75,1	20	194,3	103,3	80	247,2	131,5
41	36,2	19,2	101	89,2	47,4	161	142,2	75,6	221	195,1	103,8	281	248,1	131,9
42	37,1	19,7	02	90,1	47,9	62	143,0	76,1	22	196,0	104,2	82	249,0	132,4
43	38,0	20,2	03	90,9	48,4	63	143,9	76,5	23	196,9	104,7	83	249,9	132,9
44	38,9	20,7	04	91,8	48,8	64	144,8	77,0	24	197,8	105,2	84	250,8	133,3
45	39,7	21,1	05	92,7	49,3	65	145,7	77,5	25	198,7	105,6	85	251,7	133,8
46	40,6	21,6	06	93,6	49,8	66	146,6	77,9	26	199,6	106,1	86	252,5	134,3
47	41,5	22,1	07	94,5	50,2	67	147,5	78,4	27	200,4	106,6	87	253,4	134,7
48	42,4	22,5	08	95,4	50,7	68	148,3	78,9	28	201,3	107,0	88	254,3	135,2
49	43,3	23,0	09	96,2	51,2	69	149,2	79,3	29	202,2	107,5	89	255,2	135,7
50	44,2	23,5	10	97,1	51,6	70	150,1	79,8	30	203,1	108,0	90	256,1	136,2
51	45,0	23,9	111	98,0	52,1	171	151,0	80,3	231	204,0	108,5	291	257,0	136,6
52	45,9	24,4	12	98,9	52,6	72	151,9	80,8	32	204,9	108,9	92	257,8	137,1
53	46,8	24,9	13	99,8	53,1	73	152,8	81,2	33	205,7	109,4	93	258,7	137,6
54	47,7	25,4	14	100,7	53,5	74	153,6	81,7	34	206,6	109,9	94	259,6	138,0
55	48,6	25,8	15	101,5	54,0	75	154,5	82,2	35	207,5	110,3	95	260,5	138,5
56	49,4	26,3	16	102,4	54,5	76	155,4	82,6	36	208,4	110,8	96	261,4	139,0
57	50,3	26,8	17	103,3	54,9	77	156,3	83,1	37	209,3	111,3	97	262,3	139,4
58	51,2	27,2	18	104,2	55,4	78	157,2	83,6	38	210,2	111,7	98	263,1	139,9
59	52,1	27,7	19	105,1	55,9	79	158,1	84,0	39	211,0	112,2	99	264,0	140,4
60	53,0	28,2	20	106,0	56,3	80	158,9	84,5	40	211,9	112,7	300	264,9	140,9

Dift. Lat. Lat. Dift. Dep. Lat. Dift. Dep. Lat. Dift. Dep. Lat. Dift. Dep. Lat. Dift. Dep. Lat.

for 62 Deg.

Difference of Latitude and Departure for 29 Deg.

Dift	La.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	D p.	Dift	Lat.	Dep.	Dift	Lat.	Dep.
1	00,9	00,5	61	53,4	59,6	121	105,8	58,7	181	158,3	87,7	241	210,8	116,8
2	01,7	01,0	62	54,2	30,1	22	106,7	59,1	82	159,2	88,2	42	211,7	117,3
3	02,6	01,5	63	55,1	30,5	23	107,6	59,6	83	160,1	88,7	43	212,5	117,8
4	03,5	01,9	64	56,0	31,0	24	108,5	60,1	84	160,9	89,2	44	213,4	118,3
5	04,4	02,4	65	56,8	31,5	25	109,3	60,6	85	161,8	89,7	45	214,3	118,8
6	05,2	02,9	66	57,7	32,0	26	110,2	61,1	86	162,7	90,2	46	215,2	119,3
7	06,1	03,4	67	58,6	32,5	27	111,1	61,6	87	163,6	90,7	47	216,0	119,7
8	07,0	03,9	68	59,5	33,0	28	111,9	62,1	88	164,4	91,1	48	216,9	120,2
9	07,9	04,4	69	60,3	33,5	29	112,8	62,5	89	165,3	91,6	49	217,8	120,7
10	08,7	04,8	70	61,2	33,9	30	113,7	63,0	90	166,2	92,1	50	218,7	121,2
11	09,6	05,3	71	62,1	34,4	31	114,6	63,5	191	167,0	92,6	251	219,5	121,7
12	10,5	05,8	72	63,0	34,9	32	115,4	64,0	92	167,9	93,1	52	220,4	122,2
13	11,4	06,3	73	63,8	35,4	33	116,3	64,5	93	168,8	93,6	53	221,3	122,7
14	12,2	06,8	74	64,7	35,9	34	117,2	65,0	94	169,7	94,1	54	222,2	123,1
15	13,1	07,3	75	65,6	36,4	35	118,1	65,4	95	170,5	94,5	55	223,0	123,6
16	14,0	07,8	76	66,5	36,8	36	118,9	65,9	96	171,4	95,0	56	223,9	124,1
17	14,9	08,2	77	67,3	37,3	37	119,8	66,4	97	172,3	95,5	57	224,8	124,6
18	15,8	08,7	78	68,2	37,8	38	120,7	66,9	98	173,2	96,0	58	225,6	125,1
19	16,6	09,2	79	69,1	38,3	39	121,6	67,4	99	174,0	96,5	59	226,5	125,6
20	17,5	09,7	80	70,0	38,8	40	122,4	67,9	200	174,9	97,0	60	227,4	126,0
21	18,4	10,2	81	70,8	39,3	141	123,3	68,4	201	175,8	97,4	261	228,3	126,5
22	19,2	10,7	82	71,7	39,8	42	124,2	68,8	02	176,7	97,9	62	229,1	127,0
23	20,1	11,2	83	72,6	40,2	43	125,1	69,3	03	177,5	98,4	63	230,0	127,5
24	21,0	11,6	84	73,5	40,7	44	125,9	69,8	04	178,4	98,9	64	230,9	128,0
25	21,9	12,1	85	74,3	41,2	45	126,8	70,3	05	179,3	99,4	65	231,8	128,5
26	22,7	12,6	86	75,2	41,7	46	127,7	70,8	06	180,2	99,9	66	232,6	129,0
27	23,6	13,1	87	76,1	42,2	47	128,6	71,3	07	181,0	100,4	67	233,5	129,4
28	24,5	13,6	88	77,0	42,7	48	129,4	71,8	08	181,9	100,8	68	234,4	129,9
29	25,4	14,1	89	77,8	43,1	49	130,3	72,2	09	182,8	101,3	69	235,3	130,4
30	26,2	14,5	90	78,7	43,6	50	131,2	72,7	10	183,7	101,8	70	236,1	130,9
31	27,1	15,0	91	79,6	44,1	151	132,1	73,2	211	184,5	102,3	271	237,0	131,4
32	28,0	15,5	92	80,5	44,6	52	132,9	73,7	12	185,4	102,8	72	237,9	131,9
33	28,9	16,0	93	81,3	45,1	53	133,8	74,2	13	186,3	103,3	73	238,8	132,4
34	29,7	16,5	94	82,2	45,6	54	134,7	74,7	14	187,2	103,7	74	239,6	132,8
35	30,6	17,0	95	83,1	46,1	55	135,5	75,1	15	188,0	104,2	75	240,5	133,3
36	31,5	17,5	96	84,0	46,5	56	136,4	75,6	16	188,9	104,7	76	241,4	133,8
37	32,4	17,9	97	84,8	47,0	57	137,3	76,1	17	189,8	105,2	77	242,3	134,3
38	33,2	18,4	98	85,7	47,5	58	138,2	76,6	18	190,7	105,7	78	243,1	134,8
39	34,1	18,9	99	86,6	48,0	59	139,1	77,1	19	191,5	106,2	79	244,0	135,3
40	35,0	19,4	100	87,5	48,5	60	139,9	77,6	20	192,4	106,7	80	244,9	135,7
41	35,9	19,9	101	88,3	49,0	101	140,8	78,1	221	193,3	107,1	281	245,8	136,2
42	36,7	20,4	02	89,2	49,4	62	141,7	78,5	22	194,2	107,6	82	246,6	136,7
43	37,6	20,8	03	90,1	49,9	63	142,6	79,0	23	195,0	108,1	83	247,5	137,2
44	38,5	21,3	04	91,0	50,4	64	143,4	79,5	24	195,9	108,6	84	248,4	137,7
45	39,4	21,8	05	91,8	50,9	65	144,3	80,0	25	196,8	109,1	85	249,3	138,2
46	40,2	22,3	06	92,7	51,4	66	145,2	80,5	26	197,7	109,6	86	250,1	138,7
47	41,1	22,8	07	93,6	51,9	67	146,1	81,0	27	198,5	110,0	87	251,0	139,1
48	42,0	23,3	08	94,5	52,4	68	146,9	81,4	28	199,4	110,5	88	251,9	139,6
49	42,9	23,8	09	95,3	52,8	69	147,8	81,9	29	200,3	111,0	89	252,8	140,1
50	43,7	24,2	10	96,2	53,3	70	148,7	82,4	30	201,2	111,5	90	253,6	140,6
51	44,6	24,7	111	97,1	53,8	171	149,6	82,9	231	202,0	112,0	291	254,5	141,1
52	45,5	25,2	12	98,0	54,3	72	150,4	83,4	32	202,9	112,5	92	255,4	141,6
53	46,4	25,7	13	98,8	54,8	73	151,3	83,9	33	203,8	113,0	93	256,3	142,0
54	47,2	26,2	14	99,7	55,3	74	152,2	84,4	34	204,7	113,4	94	257,1	142,5
55	48,1	26,7	15	100,6	55,8	75	153,1	84,8	35	205,5	113,9	95	258,0	143,0
56	49,0	27,1	16	101,5	56,2	76	153,9	85,3	36	206,4	114,4	96	258,9	143,5
57	49,9	27,6	17	102,3	56,7	77	154,8	85,8	37	207,3	114,9	97	259,8	144,0
58	50,7	28,1	18	103,2	57,2	78	155,7	86,3	38	208,2	115,4	98	260,6	144,5
59	51,6	28,6	19	104,1	57,7	79	156,6	86,8	39	209,0	115,9	99	261,5	145,0
60	52,5	29,1	20	105,0	58,2	80	157,4	87,3	40	209,9	116,4	300	262,4	145,4

for 61 D g.

Difference of Latitude and Departure for 30 Deg.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00,9	00,5	61	52,8	30,5	121	104,8	60,5	181	156,7	90,5	241	208,7	120,5
2	01,7	01,0	62	53,7	31,0	22	105,7	61,0	82	157,6	91,0	42	209,6	121,0
3	02,5	01,5	63	54,6	31,5	23	106,5	61,5	83	158,5	91,5	43	210,4	121,5
4	03,3	02,0	64	55,4	32,0	24	107,4	62,0	84	159,3	92,0	44	211,3	122,0
5	04,3	02,5	65	56,3	32,5	25	108,3	62,5	85	160,2	92,5	45	212,2	122,5
6	05,2	03,0	66	57,2	33,0	26	109,1	63,0	86	161,1	93,0	46	213,1	123,0
7	06,1	03,5	67	58,0	33,5	27	110,0	63,5	87	161,9	93,5	47	213,9	123,5
8	06,9	04,0	68	58,9	34,0	28	110,8	64,0	88	162,8	94,0	48	214,8	124,0
9	07,8	04,5	69	59,8	34,5	29	111,7	64,5	89	163,7	94,5	49	215,6	124,5
10	08,7	05,0	70	60,6	35,0	30	112,6	65,0	90	164,5	95,0	50	216,5	125,0
11	09,5	05,5	71	61,5	35,5	31	113,4	65,5	191	165,4	95,5	251	217,4	125,5
12	10,4	06,0	72	62,4	36,0	32	114,3	66,0	92	166,3	96,0	52	218,2	126,0
13	11,3	06,5	73	63,2	36,5	33	115,2	66,5	93	167,1	96,5	53	219,1	126,5
14	12,1	07,0	74	64,1	37,0	34	116,0	67,0	94	168,0	97,0	54	220,0	127,0
15	13,0	07,5	75	65,0	37,5	35	116,9	67,5	95	168,9	97,5	55	220,8	127,5
16	13,9	08,0	76	65,8	38,0	36	117,8	68,0	96	169,7	98,0	56	221,7	128,0
17	14,7	08,5	77	66,7	38,5	37	118,6	68,5	97	170,6	98,5	57	222,6	128,5
18	15,6	09,0	78	67,5	39,0	38	119,5	69,0	98	171,5	99,0	58	223,4	129,0
19	16,5	09,5	79	68,4	39,5	39	120,4	69,5	99	172,3	99,5	59	224,3	129,5
20	17,3	10,0	80	69,3	40,0	40	121,2	70,0	200	173,2	100,0	60	225,2	130,0
21	18,2	10,5	81	70,1	40,5	41	122,1	70,5	201	174,1	100,5	261	226,0	130,5
22	19,1	11,0	82	71,0	41,0	42	123,0	71,0	02	174,9	101,0	62	226,9	131,0
23	19,9	11,5	83	71,9	41,5	43	123,8	71,5	03	175,8	101,5	63	227,8	131,5
24	20,8	12,0	84	72,7	42,0	44	124,7	72,0	04	176,7	102,0	64	228,6	132,0
25	21,7	12,5	85	73,6	42,5	45	125,6	72,5	05	177,5	102,5	65	229,5	132,5
26	22,5	13,0	86	74,5	43,0	46	126,4	73,0	06	178,4	103,0	66	230,4	133,0
27	23,4	13,5	87	75,3	43,5	47	127,3	73,5	07	179,3	103,5	67	231,2	133,5
28	24,2	14,0	88	76,2	44,0	48	128,2	74,0	08	180,1	104,0	68	232,1	134,0
29	25,1	14,5	89	77,1	44,5	49	129,0	74,5	09	181,0	104,5	69	233,0	134,5
30	26,0	15,0	90	77,9	45,0	50	129,9	75,0	10	181,9	105,0	70	233,8	135,0
31	26,8	15,5	91	78,8	45,5	51	130,8	75,5	211	182,7	105,5	271	234,7	135,5
32	27,7	16,0	92	79,7	46,0	52	131,6	76,0	12	183,6	106,0	72	235,6	136,0
33	28,6	16,5	93	80,5	46,5	53	132,5	76,5	13	184,5	106,5	73	236,4	136,5
34	29,4	17,0	94	81,4	47,0	54	133,4	77,0	14	185,3	107,0	74	237,3	137,0
35	30,3	17,5	95	82,3	47,5	55	134,2	77,5	15	186,2	107,5	75	238,2	137,5
36	31,2	18,0	96	83,1	48,0	56	135,1	78,0	16	187,1	108,0	76	239,0	138,0
37	32,0	18,5	97	84,0	48,5	57	136,0	78,5	17	187,9	108,5	77	239,9	138,5
38	32,9	19,0	98	84,9	49,0	58	136,8	79,0	18	188,8	109,0	78	240,7	139,0
39	33,8	19,5	99	85,7	49,5	59	137,7	79,5	19	189,7	109,5	79	241,6	139,5
40	34,6	20,0	100	86,6	50,0	60	138,6	80,0	20	190,5	110,0	80	242,5	140,0
41	35,5	20,5	101	87,5	50,5	161	139,4	80,5	221	191,4	110,5	281	243,3	140,5
42	36,4	21,0	02	88,3	51,0	62	140,3	81,0	22	192,3	111,0	82	244,2	141,0
43	37,2	21,5	03	89,2	51,5	63	141,2	81,5	23	193,1	111,5	83	245,1	141,5
44	38,1	22,0	04	90,1	52,0	64	142,0	82,0	24	194,0	112,0	84	245,9	142,0
45	39,0	22,5	05	90,9	52,5	65	142,9	82,5	25	194,9	112,5	85	246,8	142,5
46	39,8	23,0	06	91,8	53,0	66	143,8	83,0	26	195,7	113,0	86	247,7	143,0
47	40,7	23,5	07	92,7	53,5	67	144,6	83,5	27	196,6	113,5	87	248,5	143,5
48	41,5	24,0	08	93,5	54,0	68	145,5	84,0	28	197,4	114,0	88	249,4	144,0
49	42,4	24,5	09	94,4	54,5	69	146,4	84,5	29	198,3	114,5	89	250,3	144,5
50	43,3	25,0	10	95,3	55,0	70	147,2	85,0	30	199,2	115,0	90	251,1	145,0
51	44,2	25,5	111	96,1	55,5	171	148,1	85,5	231	200,0	115,5	291	252,0	145,5
52	45,0	26,0	12	97,0	56,0	72	149,0	86,0	32	200,9	116,0	92	252,9	146,0
53	45,9	26,5	13	97,9	56,5	73	149,8	86,5	33	201,8	116,5	93	253,7	146,5
54	46,8	27,0	14	98,7	57,0	74	150,7	87,0	34	202,6	117,0	94	254,6	147,0
55	47,6	27,5	15	99,6	57,5	75	151,6	87,5	35	203,5	117,5	95	255,5	147,5
56	48,5	28,0	16	100,5	58,0	76	152,4	88,0	36	204,4	118,0	96	256,3	148,0
57	49,4	28,5	17	101,3	58,5	77	153,3	88,5	37	205,2	118,5	97	257,2	148,5
58	50,2	29,0	18	102,2	59,0	78	154,1	89,0	38	206,1	119,0	98	258,1	149,0
59	51,1	29,5	19	103,1	59,5	79	155,0	89,5	39	207,0	119,5	99	258,9	149,5
60	52,0	30,0	20	104,0	60,0	80	155,8	90,0	40	207,8	120,0	300	259,8	150,0
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 60 Deg.

Difference of Latitude and Departure for 31 Deg.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00,9	00,5	61	52,3	31,4	121	103,7	62,3	181	155,1	93,2	241	206,5	124,1
2	01,7	01,0	62	53,1	31,9	22	104,6	62,8	82	156,0	93,7	42	207,4	124,6
3	02,6	01,5	63	54,0	32,4	23	105,4	63,3	83	156,8	94,2	43	208,3	125,1
4	03,4	02,1	64	54,8	33,0	24	106,3	63,9	84	157,7	94,8	44	209,1	125,6
5	04,3	02,6	65	55,7	33,5	25	107,1	64,4	85	158,5	95,3	45	210,0	126,2
6	05,1	03,1	66	56,6	34,0	26	108,0	64,9	86	159,4	95,8	46	210,8	126,7
7	06,0	03,6	67	57,4	34,5	27	108,8	65,4	87	160,3	96,3	47	211,7	127,2
8	06,9	04,1	68	58,3	35,0	28	109,7	65,9	88	161,1	96,8	48	212,5	127,7
9	07,7	04,6	69	59,1	35,5	29	110,6	66,4	89	162,0	97,3	49	213,4	128,2
10	08,6	05,2	70	60,0	36,1	30	111,4	67,0	90	162,8	97,9	50	214,3	128,8
11	09,4	05,7	71	60,8	36,6	131	112,3	67,5	191	163,7	98,4	251	215,1	129,3
12	10,3	06,2	72	61,7	37,1	32	113,1	68,0	92	164,5	98,9	52	216,0	129,8
13	11,1	06,7	73	62,6	37,6	33	114,0	68,5	93	165,4	99,4	53	216,8	130,3
14	12,0	07,2	74	63,4	38,1	34	114,8	69,0	94	166,3	99,9	54	217,7	130,8
15	12,9	07,7	75	64,3	38,6	35	115,7	69,5	95	167,1	100,4	55	218,5	131,3
16	13,7	08,2	76	65,1	39,1	36	116,6	70,0	96	168,0	100,9	56	219,4	131,8
17	14,6	08,8	77	66,0	39,7	37	117,4	70,6	97	168,8	101,5	57	220,2	132,4
18	15,4	09,3	78	66,8	40,2	38	118,3	71,1	98	169,7	102,0	58	221,1	132,9
19	16,3	09,8	79	67,7	40,7	39	119,1	71,6	99	170,5	102,5	59	222,0	133,4
20	17,1	10,3	80	68,6	41,2	40	120,0	72,1	200	171,4	103,0	60	222,8	133,9
21	18,0	10,8	81	69,4	41,7	141	120,8	72,6	201	172,3	103,5	261	223,7	134,4
22	18,9	11,3	82	70,3	42,2	42	121,7	73,1	02	173,1	104,0	62	224,5	134,9
23	19,7	11,8	83	71,1	42,7	43	122,6	73,6	03	174,0	104,5	63	225,4	135,4
24	20,6	12,4	84	72,0	43,3	44	123,4	74,2	04	174,8	105,1	64	226,2	136,0
25	21,4	12,9	85	72,8	43,8	45	124,3	74,7	05	175,7	105,6	65	227,1	136,5
26	22,3	13,4	86	73,7	44,3	46	125,1	75,2	06	176,5	106,1	66	228,0	137,0
27	23,1	13,9	87	74,6	44,8	47	126,0	75,7	07	177,4	106,6	67	228,8	137,5
28	24,0	14,4	88	75,4	45,3	48	126,8	76,2	08	178,3	107,1	68	229,7	138,0
29	24,9	14,9	89	76,3	45,8	49	127,7	76,7	09	179,1	107,6	69	230,5	138,5
30	25,7	15,5	90	77,1	46,4	50	128,6	77,3	10	180,0	108,2	70	231,4	139,1
31	26,6	16,0	91	78,0	46,9	151	129,4	77,8	211	180,8	108,7	271	232,2	139,6
32	27,4	16,5	92	78,8	47,4	52	130,3	78,3	12	181,7	109,2	72	233,1	140,1
33	28,3	17,0	93	79,7	47,9	53	131,1	78,8	13	182,5	109,7	73	234,0	140,6
34	29,1	17,5	94	80,6	48,4	54	132,0	79,3	14	183,4	110,2	74	234,8	141,1
35	30,0	18,0	95	81,4	48,9	55	132,8	79,8	15	184,3	110,7	75	235,7	141,6
36	30,9	18,5	96	82,3	49,4	56	133,7	80,3	16	185,1	111,2	76	236,5	142,1
37	31,7	19,1	97	83,1	50,0	57	134,5	80,9	17	186,0	111,8	77	237,4	142,7
38	32,6	19,6	98	84,0	50,5	58	135,4	81,4	18	186,8	112,3	78	238,2	143,2
39	33,4	20,1	99	84,8	51,0	59	136,3	81,9	19	187,7	112,8	79	239,1	143,7
40	34,3	20,6	100	85,7	51,5	60	137,1	82,4	20	188,5	113,3	80	240,0	144,2
41	35,1	21,1	101	86,6	52,0	161	138,0	82,9	221	189,4	113,8	281	240,8	144,7
42	36,0	21,6	02	87,4	52,5	62	138,8	83,4	22	190,3	114,3	82	241,7	145,2
43	36,9	22,1	03	88,3	53,0	63	139,7	83,9	23	191,1	114,8	83	242,5	145,7
44	37,7	22,6	04	89,1	53,6	64	140,5	84,5	24	192,0	115,4	84	243,4	146,3
45	38,6	23,2	05	90,0	54,1	65	141,4	85,0	25	192,8	115,9	85	244,2	146,8
46	39,4	23,7	06	90,8	54,6	66	142,3	85,5	26	193,7	116,4	86	245,1	147,3
47	40,3	24,2	07	91,7	55,1	67	143,1	86,0	27	194,5	116,9	87	246,0	147,8
48	41,1	24,7	08	92,6	55,6	68	144,0	86,5	28	195,4	117,4	88	246,8	148,3
49	42,0	25,2	09	93,4	56,1	69	144,8	87,0	29	196,3	117,9	89	247,7	148,8
50	42,9	25,8	10	94,3	56,7	70	145,7	87,6	30	197,1	118,5	90	248,5	149,4
51	43,7	26,3	111	95,1	57,2	171	146,5	88,1	231	198,0	119,0	291	249,4	149,9
52	44,6	26,8	12	96,0	57,7	72	147,4	88,6	32	198,8	119,5	92	250,2	150,4
53	45,4	27,3	13	96,8	58,2	73	148,3	89,1	33	199,7	120,0	93	251,1	150,9
54	46,3	27,8	14	97,7	58,7	74	149,1	89,6	34	200,5	120,5	94	252,0	151,4
55	47,1	28,3	15	98,6	59,2	75	150,0	90,1	35	201,4	121,0	95	252,8	151,9
56	48,0	28,8	16	99,4	59,7	76	150,8	90,6	36	202,3	121,5	96	253,7	152,4
57	48,8	29,4	17	100,3	60,3	77	151,7	91,2	37	203,1	122,1	97	254,5	153,0
58	49,7	29,9	18	101,1	60,8	78	152,5	91,7	38	204,0	122,6	98	255,4	153,5
59	50,6	30,4	19	102,0	61,3	79	153,4	92,2	39	204,8	123,1	99	256,2	154,0
60	51,4	30,9	20	102,8	61,8	80	154,3	92,7	40	205,7	123,6	300	257,1	154,5
Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.

Difference of Latitude and Departure for 32 Deg.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00,8	00,5	61	51,7	32,3	121	102,6	64,1	181	153,5	95,9	241	204,4	127,7
2	01,7	01,1	62	52,6	32,9	22	103,5	64,7	82	154,3	96,5	42	205,2	128,3
3	02,5	01,6	63	53,4	33,4	23	104,3	65,2	83	155,2	97,0	43	206,1	128,8
4	03,4	02,1	64	54,3	33,9	24	105,2	65,7	84	156,0	97,5	44	206,9	129,3
5	04,2	02,7	65	55,1	34,5	25	106,0	66,3	85	156,9	98,1	45	207,8	129,9
6	05,1	03,2	66	56,0	35,0	26	106,8	66,8	86	157,7	98,6	46	208,6	130,4
7	05,9	03,7	67	56,8	35,5	27	107,7	67,3	87	158,6	99,1	47	209,5	130,9
8	06,8	04,2	68	57,7	36,0	28	108,5	67,8	88	159,4	99,6	48	210,3	131,4
9	07,6	04,8	69	58,5	36,6	29	109,4	68,4	89	160,3	100,2	49	211,2	132,0
10	08,5	05,3	70	59,4	37,1	30	110,2	68,9	90	161,1	100,7	50	212,0	132,5
11	09,3	05,8	71	60,2	37,6	131	111,1	69,4	191	162,0	101,2	251	212,8	133,0
12	10,2	06,4	72	61,1	38,2	32	111,9	70,0	92	162,8	101,8	52	213,7	133,6
13	11,0	06,9	73	61,9	38,7	33	112,8	70,5	93	163,7	102,3	53	214,5	134,1
14	11,9	07,4	74	62,8	39,2	34	113,6	71,0	94	164,5	102,8	54	215,4	134,6
15	12,7	08,0	75	63,6	39,8	35	114,5	71,6	95	165,4	103,4	55	216,2	135,2
16	13,6	08,5	76	64,4	40,3	36	115,3	72,1	96	166,2	103,9	56	217,1	135,7
17	14,4	09,0	77	65,3	40,8	37	116,2	72,6	97	167,1	104,4	57	217,9	136,2
18	15,3	09,5	78	66,1	41,3	38	117,0	73,1	98	167,9	104,9	58	218,8	136,7
19	16,1	10,1	79	67,0	41,9	39	117,9	73,7	99	168,8	105,5	59	219,6	137,3
20	17,0	10,6	80	67,8	42,4	40	118,7	74,2	200	169,6	106,0	60	220,5	137,8
21	17,8	11,1	81	68,7	42,9	141	119,6	74,7	201	170,4	106,5	261	221,3	138,3
22	18,7	11,7	82	69,5	43,5	42	120,4	75,3	02	171,3	107,1	62	222,2	138,9
23	19,5	12,2	83	70,4	44,0	43	121,3	75,8	03	172,1	107,6	63	223,0	139,4
24	20,4	12,7	84	71,2	44,5	44	122,1	76,3	04	173,0	108,1	64	223,9	139,9
25	21,2	13,3	85	72,1	45,1	45	123,0	76,9	05	173,8	108,7	65	224,7	140,5
26	22,0	13,8	86	72,9	45,6	46	123,8	77,4	06	174,7	109,2	66	225,6	141,0
27	22,9	14,3	87	73,8	46,1	47	124,7	77,9	07	175,5	109,7	67	226,4	141,5
28	23,7	14,8	88	74,6	46,6	48	125,5	78,4	08	176,4	110,2	68	227,3	142,0
29	24,6	15,4	89	75,5	47,2	49	126,4	79,0	09	177,2	110,8	69	228,1	142,6
30	25,4	15,9	90	76,3	47,7	50	127,2	79,5	10	178,1	111,3	70	229,0	143,1
31	26,3	16,4	91	77,2	48,2	151	128,0	80,0	211	178,9	111,8	271	229,8	143,6
32	27,1	17,0	92	78,0	48,8	52	128,9	80,6	12	179,8	112,4	72	230,7	144,2
33	28,0	17,5	93	78,9	49,3	53	129,7	81,1	13	180,6	112,9	73	231,5	144,7
34	28,8	18,0	94	79,7	49,8	54	130,6	81,6	14	181,5	113,4	74	232,4	145,2
35	29,7	18,6	95	80,6	50,4	55	131,4	82,2	15	182,3	114,0	75	233,2	145,8
36	30,5	19,1	96	81,4	50,9	56	132,3	82,7	16	183,2	114,5	76	234,0	146,3
37	31,4	19,6	97	82,3	51,4	57	133,1	83,2	17	184,0	115,0	77	234,9	146,8
38	32,2	20,1	98	83,1	51,9	58	134,0	83,7	18	184,9	115,5	78	235,7	147,3
39	33,1	20,7	99	84,0	52,5	59	134,8	84,3	19	185,7	116,1	79	236,6	147,9
40	33,9	21,2	100	84,8	53,0	60	135,7	84,8	20	186,6	116,6	80	237,4	148,4
41	34,8	21,7	101	85,6	53,5	161	136,5	85,3	221	187,4	117,1	281	238,3	148,9
42	35,6	22,3	02	86,5	54,1	62	137,4	85,9	22	188,3	117,7	82	239,1	149,5
43	36,5	22,8	03	87,3	54,6	63	138,2	86,4	23	189,1	118,2	83	240,0	150,0
44	37,3	23,3	04	88,2	55,1	64	139,1	86,9	24	190,0	118,7	84	240,8	150,5
45	38,2	23,9	05	89,0	55,7	65	139,9	87,5	25	190,8	119,3	85	241,7	151,1
46	39,0	24,4	06	89,9	56,2	66	140,8	88,0	26	191,6	119,8	86	242,5	151,6
47	39,9	24,9	07	90,7	56,7	67	141,6	88,5	27	192,5	120,3	87	243,4	152,1
48	40,7	25,4	08	91,6	57,2	68	142,5	89,0	28	193,3	120,8	88	244,2	152,6
49	41,6	26,0	09	92,4	57,8	69	143,3	89,6	29	194,2	121,4	89	245,1	153,2
50	42,4	26,5	10	93,3	58,3	70	144,2	90,1	30	195,0	121,9	90	245,9	153,7
51	43,2	27,0	111	94,1	58,8	171	145,0	90,6	231	195,9	122,4	291	246,8	154,2
52	44,1	27,6	12	95,0	59,4	72	145,9	91,2	32	196,7	123,0	92	247,6	154,8
53	44,9	28,1	13	95,8	59,9	73	146,7	91,7	33	197,6	123,5	93	248,5	155,3
54	45,8	28,6	14	96,7	60,4	74	147,6	92,2	34	198,4	124,0	94	249,3	155,8
55	46,6	29,2	15	97,5	61,0	75	148,4	92,8	35	199,3	124,6	95	250,2	156,4
56	47,5	29,7	16	98,4	61,5	76	149,2	93,3	36	200,1	125,1	96	251,0	156,9
57	48,3	30,2	17	99,2	62,0	77	150,1	93,8	37	201,0	125,6	97	251,9	157,4
58	49,2	30,7	18	100,1	62,5	78	150,9	94,3	38	201,8	126,1	98	252,7	157,9
59	50,0	31,3	19	100,9	63,1	79	151,8	94,9	39	202,7	126,7	99	253,6	158,5
60	50,9	31,8	20	101,8	63,6	80	152,6	95,4	40	203,5	127,2	300	254,4	159,0
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	D. p.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 58 Deg.

Difference of Latitude and Departure for 33 Deg.

Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.
1	00,8	00,5	61	51,2	33,2	121	101,5	65,9	181	151,8	98,6	241	202,1	131,2
2	01,7	01,1	62	52,0	33,8	22	102,3	66,4	82	152,6	99,1	42	202,9	131,8
3	02,5	01,6	63	52,8	34,3	23	103,1	67,0	83	153,5	99,7	43	203,8	132,3
4	03,4	02,2	64	53,7	34,9	24	104,0	67,5	84	154,3	100,2	44	204,6	132,9
5	04,2	02,7	65	54,5	35,4	25	104,8	68,1	85	155,1	100,8	45	205,5	133,4
6	05,0	03,3	66	55,3	35,9	26	105,7	68,6	86	156,0	101,3	46	206,3	134,0
7	05,9	03,8	67	56,2	36,5	27	106,5	69,2	87	156,8	101,8	47	207,1	134,5
8	06,7	04,3	68	57,0	37,0	28	107,3	69,7	88	157,7	102,4	48	208,0	135,1
9	07,5	04,9	69	57,9	37,6	29	108,2	70,3	89	158,5	102,9	49	208,8	135,6
10	08,4	05,4	70	58,7	38,1	30	109,0	70,8	90	159,3	103,5	50	209,7	136,2
11	09,2	06,0	71	59,5	38,7	31	109,9	71,3	191	160,2	104,0	251	210,5	136,7
12	10,1	06,5	72	60,4	39,2	32	110,7	71,9	92	161,0	104,6	52	211,3	137,2
13	10,9	07,1	73	61,2	39,8	33	111,5	72,4	93	161,8	105,1	53	212,2	137,8
14	11,7	07,6	74	62,1	40,3	34	112,4	73,0	94	162,7	105,7	54	213,0	138,3
15	12,6	08,2	75	62,9	40,8	35	113,2	73,5	95	163,5	106,2	55	213,8	138,9
16	13,4	08,7	76	63,7	41,4	36	114,0	74,1	96	164,4	106,7	56	214,7	139,4
17	14,3	09,3	77	64,6	41,9	37	114,9	74,6	97	165,2	107,3	57	215,5	140,0
18	15,1	09,8	78	65,4	42,5	38	115,7	75,2	98	166,0	107,8	58	216,4	140,5
19	15,9	10,3	79	66,2	43,0	39	116,6	75,7	99	166,9	108,4	59	217,2	141,1
20	16,8	10,9	80	67,1	43,6	40	117,4	76,2	200	167,7	108,9	60	218,0	141,6
21	17,6	11,4	81	67,9	44,1	141	118,2	76,8	201	168,6	109,5	261	218,9	142,1
22	18,4	12,0	82	68,8	44,7	42	119,1	77,3	02	169,4	110,0	62	219,7	142,7
23	19,3	12,5	83	69,6	45,2	43	119,9	77,9	03	170,2	110,6	63	220,6	143,2
24	20,1	13,1	84	70,4	45,7	44	120,8	78,4	04	171,1	111,1	64	221,4	143,8
25	21,0	13,6	85	71,3	46,3	45	121,6	79,0	05	171,9	111,6	65	222,2	144,3
26	21,8	14,2	86	72,1	46,8	46	122,4	79,5	06	172,8	112,2	66	223,1	144,9
27	22,6	14,7	87	73,0	47,4	47	123,3	80,1	07	173,6	112,7	67	223,9	145,4
28	23,5	15,2	88	73,8	47,9	48	124,1	80,6	08	174,4	113,3	68	224,7	146,0
29	24,3	15,8	89	74,6	48,5	49	125,0	81,1	09	175,3	113,8	69	225,6	146,5
30	25,2	16,3	90	75,5	49,0	50	125,8	81,7	10	176,1	114,4	70	226,4	147,0
31	26,0	16,9	91	76,3	49,6	151	126,6	82,2	211	176,9	114,9	271	227,3	147,6
32	26,8	17,4	92	77,2	50,1	52	127,5	82,8	12	177,8	115,5	72	228,1	148,1
33	27,7	18,0	93	78,0	50,6	53	128,3	83,3	13	178,6	116,0	73	228,9	148,7
34	28,5	18,5	94	78,8	51,2	54	129,1	83,9	14	179,5	116,5	74	229,8	149,2
35	29,4	19,1	95	79,7	51,7	55	130,0	84,4	15	180,3	117,1	75	230,6	149,8
36	30,2	19,6	96	80,5	52,3	56	130,8	85,0	16	181,1	117,6	76	231,5	150,3
37	31,0	20,2	97	81,3	52,8	57	131,7	85,5	17	182,0	118,2	77	232,3	150,9
38	31,9	20,7	98	82,2	53,4	58	132,5	86,0	18	182,8	118,7	78	233,1	151,4
39	32,7	21,2	99	83,0	53,9	59	133,3	86,6	19	183,7	119,3	79	234,0	151,9
40	33,5	21,8	100	83,9	54,5	60	134,2	87,1	20	184,5	119,8	80	234,8	152,5
41	34,4	22,3	101	84,7	55,0	161	135,0	87,7	221	185,3	120,4	281	235,6	153,0
42	35,2	22,9	02	85,5	55,5	62	135,9	88,2	22	186,2	120,9	82	236,5	153,6
43	36,1	23,4	03	86,4	56,1	63	136,7	88,8	23	187,0	121,4	83	237,3	154,1
44	36,9	24,0	04	87,1	56,6	64	137,5	89,3	24	187,8	122,0	84	238,2	154,7
45	37,7	24,5	05	88,1	57,2	65	138,4	89,9	25	188,7	122,5	85	239,0	155,2
46	38,5	25,1	06	88,9	57,7	66	139,2	90,4	26	189,5	123,1	86	239,8	155,8
47	39,4	25,6	07	89,7	58,3	67	140,0	90,9	27	190,4	123,6	87	240,7	156,3
48	40,3	26,1	08	90,6	58,8	68	140,9	91,5	28	191,2	124,2	88	241,5	156,8
49	41,1	26,7	09	91,4	59,4	69	141,7	92,0	29	192,0	124,7	89	242,4	157,4
50	41,9	27,2	10	92,2	59,9	70	142,6	92,6	30	192,9	125,3	90	243,2	157,9
51	42,8	27,8	111	93,1	60,5	171	143,4	93,1	231	193,7	125,8	291	244,0	158,5
52	43,6	28,3	12	93,9	61,0	72	144,2	93,7	32	194,6	126,3	92	244,9	159,0
53	44,4	28,9	13	94,8	61,5	73	145,1	94,2	33	195,4	126,9	93	245,7	159,6
54	45,3	29,4	14	95,6	62,1	74	145,9	94,8	34	196,2	127,4	94	246,5	160,1
55	46,1	30,0	15	96,4	62,6	75	146,8	95,3	35	197,1	128,0	95	247,4	160,7
56	47,0	30,5	16	97,3	63,2	76	147,6	95,8	36	197,9	128,5	96	248,2	161,2
57	47,8	31,0	17	98,1	63,7	77	148,4	96,4	37	198,7	129,1	97	249,1	161,7
58	48,6	31,6	18	99,0	64,3	78	149,3	96,9	38	199,6	129,6	98	249,9	162,3
59	49,5	32,1	19	99,8	64,8	79	150,1	97,5	39	200,4	130,2	99	250,7	162,8
60	50,3	32,7	20	100,6	65,4	80	150,9	98,0	40	201,3	130,7	300	251,6	163,4
Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.

Difference of Latitude and Departure for 34 Deg.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00,8	00,6	61	50,6	34,1	121	100,5	67,7	181	150,0	101,2	241	199,8	134,8
2	01,7	01,1	62	51,4	34,7	22	101,1	68,2	82	150,9	101,8	42	200,6	135,3
3	02,5	01,7	63	52,2	35,2	23	102,0	68,8	83	151,7	102,3	43	201,4	135,9
4	03,3	02,2	64	53,1	35,8	24	102,8	69,3	84	152,5	102,9	44	202,3	136,4
5	04,1	02,8	65	53,9	36,3	25	103,6	69,9	85	153,4	103,5	45	203,1	137,0
6	05,0	03,4	66	54,7	36,9	26	104,5	70,5	86	154,2	104,0	46	203,9	137,6
7	05,8	03,9	67	55,5	37,5	27	105,3	71,0	87	155,0	104,6	47	204,8	138,1
8	06,6	04,5	68	56,4	38,0	28	106,1	71,6	88	155,9	105,1	48	205,6	138,7
9	07,5	05,0	69	57,2	38,6	29	106,9	72,1	89	156,7	105,7	49	206,4	139,2
10	08,3	05,6	70	58,0	39,1	30	107,8	72,7	90	157,5	106,2	50	207,3	139,8
11	09,1	06,2	71	58,9	39,7	31	108,6	73,3	91	158,3	106,8	51	208,1	140,4
12	09,9	06,7	72	59,7	40,3	32	109,4	73,8	92	159,2	107,4	52	208,9	140,9
13	10,8	07,3	73	60,5	40,8	33	110,3	74,4	93	160,0	107,9	53	209,7	141,5
14	11,6	07,8	74	61,3	41,4	34	111,1	74,9	94	160,8	108,5	54	210,6	142,0
15	12,4	08,4	75	62,2	41,9	35	111,9	75,5	95	161,7	109,0	55	211,4	142,6
16	13,3	08,9	76	63,0	42,5	36	112,7	76,1	96	162,5	109,6	56	212,2	143,2
17	14,1	09,5	77	63,8	43,1	37	113,6	76,6	97	163,3	110,2	57	213,1	143,7
18	14,9	10,1	78	64,7	43,6	38	114,4	77,2	98	164,1	110,7	58	213,9	144,3
19	15,8	10,6	79	65,5	44,2	39	115,2	77,7	99	165,0	111,3	59	214,7	144,8
20	16,6	11,2	80	66,3	44,7	40	116,1	78,3	200	165,8	111,8	60	215,5	145,4
21	17,4	11,7	81	67,1	45,3	41	116,9	78,8	201	166,6	112,4	61	216,4	146,0
22	18,2	12,3	82	68,0	45,9	42	117,7	79,4	02	167,5	113,0	62	217,2	146,5
23	19,1	12,9	83	68,8	46,4	43	118,5	80,0	03	168,3	113,5	63	218,0	147,1
24	19,9	13,4	84	69,6	47,0	44	119,4	80,5	04	169,1	114,1	64	218,9	147,6
25	20,7	14,0	85	70,5	47,5	45	120,2	81,1	05	169,9	114,6	65	219,7	148,2
26	21,6	14,5	86	71,3	48,1	46	121,0	81,6	06	170,8	115,2	66	220,5	148,7
27	22,4	15,1	87	72,1	48,7	47	121,9	82,2	07	171,6	115,8	67	221,3	149,3
28	23,2	15,7	88	73,0	49,2	48	122,7	82,8	08	172,4	116,3	68	222,2	149,9
29	24,0	16,2	89	73,8	49,8	49	123,5	83,3	09	173,3	116,9	69	223,0	150,4
30	24,9	16,8	90	74,6	50,3	50	124,4	83,9	10	174,1	117,4	70	223,8	151,0
31	25,7	17,3	91	75,4	50,9	51	125,2	84,4	211	174,9	118,0	271	224,7	151,5
32	26,5	17,9	92	76,3	51,4	52	126,0	85,0	12	175,7	118,6	72	225,5	152,1
33	27,4	18,5	93	77,1	52,0	53	126,8	85,6	13	176,6	119,1	73	226,3	152,7
34	28,2	19,0	94	77,9	52,6	54	127,7	86,1	14	177,4	119,7	74	227,1	153,2
35	29,0	19,6	95	78,8	53,1	55	128,5	86,7	15	178,2	120,2	75	228,0	153,8
36	29,8	20,1	96	79,6	53,7	56	129,3	87,2	16	179,1	120,8	76	228,8	154,3
37	30,7	20,7	97	80,4	54,2	57	130,2	87,8	17	179,9	121,3	77	229,6	154,9
38	31,5	21,2	98	81,2	54,8	58	131,0	88,4	18	180,7	121,9	78	230,5	155,5
39	32,3	21,8	99	82,1	55,4	59	131,8	88,9	19	181,6	122,5	79	231,3	156,0
40	33,2	22,4	100	82,9	55,9	60	132,6	89,5	20	182,4	123,0	80	232,1	156,6
41	34,0	22,9	101	83,7	56,5	161	133,5	90,0	221	183,2	123,6	281	232,9	157,1
42	34,8	23,5	02	84,6	57,0	62	134,3	90,6	22	184,0	124,1	82	233,8	157,7
43	35,6	24,0	03	85,4	57,6	63	135,1	91,1	23	184,9	124,7	83	234,6	158,3
44	36,5	24,6	04	86,2	58,2	64	136,0	91,7	24	185,7	125,3	84	235,4	158,8
45	37,3	25,2	05	87,0	58,7	65	136,8	92,3	25	186,5	125,8	85	236,3	159,4
46	38,1	25,7	06	87,9	59,3	66	137,6	92,8	26	187,4	126,4	86	237,1	159,9
47	39,0	26,3	07	88,7	59,8	67	138,4	93,4	27	188,2	126,9	87	237,9	160,5
48	39,8	26,8	08	89,5	60,4	68	139,3	93,9	28	189,0	127,5	88	238,8	161,0
49	40,6	27,4	09	90,4	61,0	69	140,1	94,5	29	189,8	128,1	89	239,6	161,6
50	41,5	28,0	10	91,2	61,5	70	140,9	95,1	30	190,7	128,6	290	240,4	162,2
51	42,3	28,5	111	92,0	62,1	171	141,8	95,6	231	191,5	129,2	291	241,2	162,7
52	43,1	29,1	12	92,8	62,6	72	142,6	96,2	32	192,3	129,7	92	242,1	163,3
53	43,9	29,6	13	93,7	63,2	73	143,4	96,7	33	193,2	130,3	93	242,9	163,8
54	44,8	30,2	14	94,5	63,7	74	144,2	97,3	34	194,0	130,9	94	243,7	164,4
55	45,6	30,8	15	95,3	64,3	75	145,1	97,9	35	194,8	131,4	95	244,6	165,0
56	46,4	31,3	16	96,2	64,9	76	145,9	98,4	36	195,6	132,0	96	245,4	165,5
57	47,3	31,9	17	97,0	65,4	77	146,7	99,0	37	196,5	132,5	97	246,2	166,1
58	48,1	32,4	18	97,8	66,0	78	147,6	99,5	38	197,3	133,1	98	247,0	166,6
59	48,9	33,0	19	98,7	66,5	79	148,4	100,1	39	198,1	133,6	99	247,9	167,2
60	49,7	33,5	20	99,5	67,1	80	149,2	100,7	40	199,0	134,2	200	248,7	167,8

for 56 Deg.

Difference of Latitude and Departure for 35 Deg.

Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.
1	00,8	00,6	61	50,0	35,0	121	99,1	69,4	131	148,2	103,8	241	197,4	138,2	341	246,6	188,8
2	01,6	01,1	62	50,8	35,6	22	99,9	70,0	82	149,1	104,4	42	198,2	138,8	251	255,4	194,4
3	02,5	01,7	63	51,6	36,1	23	100,7	70,5	83	149,9	105,0	43	199,0	139,4	261	264,2	200,0
4	03,3	02,3	64	52,4	36,7	24	101,6	71,1	84	150,7	105,5	44	199,8	139,9	271	273,0	205,6
5	04,1	02,9	65	53,2	37,3	25	102,4	71,7	85	151,5	106,1	45	200,6	140,5	281	281,8	211,2
6	04,9	03,4	66	54,1	37,9	26	103,2	72,3	86	152,3	106,7	46	201,5	141,1	291	290,6	216,8
7	05,7	04,0	67	54,9	38,4	27	104,0	72,8	87	153,1	107,2	47	202,3	141,7	301	300,4	222,4
8	06,6	04,6	68	55,7	39,0	28	104,8	73,4	88	154,0	107,8	48	203,1	142,2	311	309,2	228,0
9	07,4	05,2	69	56,5	39,6	29	105,6	74,0	89	154,8	108,4	49	203,9	142,8	321	318,0	233,6
10	08,2	05,7	70	57,3	40,1	30	106,5	74,6	90	155,6	109,0	50	204,7	143,4	331	326,8	239,2
11	09,0	06,3	71	58,1	40,7	31	107,3	75,1	191	156,4	109,5	251	205,6	143,9	341	335,6	244,8
12	09,8	06,9	72	59,0	41,3	32	108,1	75,7	92	157,2	110,1	52	206,4	144,5	351	344,4	250,4
13	10,6	07,5	73	59,8	41,9	33	108,9	76,3	93	158,1	110,7	53	207,2	145,1	361	353,2	256,0
14	11,5	08,0	74	60,6	42,4	34	109,7	76,8	94	158,9	111,3	54	208,0	145,7	371	362,0	261,6
15	12,3	08,6	75	61,4	43,0	35	110,6	77,4	95	159,7	111,8	55	208,8	146,2	381	370,8	267,2
16	13,1	09,2	76	62,2	43,6	36	111,4	78,0	96	160,5	112,4	56	209,6	146,8	391	379,6	272,8
17	13,9	09,7	77	63,1	44,2	37	112,2	78,6	97	161,3	113,0	57	210,5	147,4	401	388,4	278,4
18	14,7	10,3	78	63,9	44,7	38	113,0	79,1	98	162,2	113,6	58	211,3	148,0	411	397,2	284,0
19	15,6	10,9	79	64,7	45,3	39	113,8	79,7	99	163,0	114,1	59	212,1	148,5	421	406,0	289,6
20	16,4	11,5	80	65,5	45,9	40	114,6	80,3	200	163,8	114,7	60	212,9	149,1	431	414,8	295,2
21	17,2	12,0	81	66,3	46,5	141	115,5	80,9	201	164,6	115,3	261	213,8	149,7	441	423,6	300,8
22	18,0	12,6	82	67,2	47,0	42	116,3	81,4	02	165,4	115,8	62	214,6	150,3	451	432,4	306,4
23	18,8	13,2	83	68,0	47,6	43	117,1	82,0	03	166,3	116,4	63	215,4	150,8	461	441,2	312,0
24	19,6	13,8	84	68,8	48,2	44	117,9	82,6	04	167,1	117,0	64	216,2	151,4	471	450,0	317,6
25	20,5	14,3	85	69,6	48,7	45	118,8	83,2	05	167,9	117,6	65	217,0	152,0	481	458,8	323,2
26	21,3	14,9	86	70,4	49,3	46	119,6	83,7	06	168,7	118,1	66	217,8	152,6	491	467,6	328,8
27	22,1	15,5	87	71,3	49,9	47	120,4	84,3	07	169,5	118,7	67	218,7	153,1	501	476,4	334,4
28	22,9	16,1	88	72,1	50,5	48	121,2	84,9	08	170,3	119,3	68	219,5	153,7	511	485,2	340,0
29	23,8	16,6	89	72,9	51,0	49	122,0	85,5	09	171,2	119,9	69	220,3	154,3	521	494,0	345,6
30	24,6	17,2	90	73,7	51,6	50	122,8	86,0	10	172,0	120,4	70	221,1	154,8	531	502,8	351,2
31	25,4	17,8	91	74,5	52,2	151	123,7	86,6	211	172,8	121,0	271	221,9	155,4	541	511,6	356,8
32	26,2	18,4	92	75,3	52,8	52	124,5	87,2	12	173,6	121,6	72	222,8	156,0	551	520,4	362,4
33	27,0	18,9	93	76,2	53,3	53	125,3	87,7	13	174,4	122,2	73	223,6	156,6	561	529,2	368,0
34	27,8	19,5	94	77,0	53,9	54	126,1	88,3	14	175,3	122,7	74	224,4	157,1	571	538,0	373,6
35	28,7	20,1	95	77,8	54,5	55	126,9	88,9	15	176,1	123,3	75	225,2	157,7	581	546,8	379,2
36	29,5	20,6	96	78,6	55,1	56	127,8	89,5	16	176,9	123,9	76	226,0	158,3	591	555,6	384,8
37	30,3	21,2	97	79,4	55,6	57	128,6	90,0	17	177,7	124,4	77	226,9	158,9	601	564,4	390,4
38	31,1	21,8	98	80,3	56,2	58	129,4	90,6	18	178,5	125,0	78	227,7	159,4	611	573,2	396,0
39	31,9	22,4	99	81,1	56,8	59	130,2	91,2	19	179,4	125,6	79	228,5	160,0	621	582,0	401,6
40	32,8	22,9	100	81,9	57,4	60	131,0	91,8	20	180,2	126,2	80	229,3	160,6	631	590,8	407,2
41	33,6	23,5	101	82,7	57,9	161	131,9	92,3	221	181,0	126,7	281	230,1	161,2	641	599,6	412,8
42	34,4	24,1	02	83,5	58,5	62	132,7	92,9	22	181,8	127,3	82	231,0	161,7	651	608,4	418,4
43	35,2	24,7	03	84,4	59,1	63	133,5	93,5	23	182,6	127,9	83	231,8	162,3	661	617,2	424,0
44	36,0	25,2	04	85,2	59,6	64	134,3	94,1	24	183,5	128,5	84	232,6	162,9	671	626,0	429,6
45	36,9	25,8	05	86,0	60,2	65	135,1	94,6	25	184,3	129,0	85	233,4	163,4	681	634,8	435,2
46	37,7	26,4	06	86,8	60,8	66	136,0	95,2	26	185,1	129,6	86	234,2	164,0	691	643,6	440,8
47	38,5	27,0	07	87,6	61,4	67	136,8	95,8	27	185,9	130,2	87	235,0	164,6	701	652,4	446,4
48	39,3	27,5	08	88,5	61,9	68	137,6	96,3	28	186,7	130,8	88	235,9	165,2	711	661,2	452,0
49	40,1	28,1	09	89,3	62,5	69	138,4	96,9	29	187,5	131,3	89	236,7	165,7	721	670,0	457,6
50	41,0	28,7	10	90,1	63,1	70	139,2	97,5	30	188,4	131,9	90	237,5	166,3	731	678,8	463,2
51	41,8	29,2	111	90,9	63,7	171	140,0	98,1	231	189,2	132,5	291	238,3	166,9	741	687,6	468,8
52	42,6	29,8	12	91,7	64,2	72	140,9	98,6	32	190,0	133,1	92	239,1	167,4	751	696,4	474,4
53	43,4	30,4	13	92,5	64,8	73	141,7	99,2	33	190,8	133,6	93	240,0	168,0	761	705,2	480,0
54	44,2	31,0	14	93,4	65,4	74	142,5	99,8	34	191,6	134,2	94	240,8	168,6	771	714,0	485,6
55	45,0	31,5	15	94,2	66,0	75	143,3	100,4	35	192,5	134,8	95	241,6	169,2	781	722,8	491,2
56	45,9	32,1	16	95,0	66,5	76	144,1	100,9	36	193,3	135,3	96	242,4	169,8	791	731,6	496,8
57	46,7	32,7	17	95,8	67,1	77	145,0	101,5	37	194,1	135,9	97	243,2	170,3	801	740,4	502,4
58	47,5	33,3	18	96,6	67,7	78	145,8	102,1	38	194,9	136,5	98	244,1	170,9	811	749,2	508,0
59	48,3	33,8	19	97,5	68,2	79	146,6	102,7	39	195,7	137,1	99	244,9	171,5	821	758,0	513,6
60	49,1	34,4	20	98,3	68,8	80	147,4	103,2	40	196,6	137,6	300	245,7	172,1	831	766,8	519,2
Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.

Difference of Latitude and Departure for 36 Deg.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00,3	00,6	61	49,3	35,9	121	97,9	71,1	181	146,4	106,4	241	195,0	141,7
2	01,6	01,2	62	50,2	36,4	22	98,7	71,7	82	147,2	107,0	42	195,8	142,2
3	02,4	01,8	63	51,0	37,0	23	99,5	72,3	83	148,0	107,6	43	196,6	142,8
4	03,2	02,4	64	51,8	37,6	24	100,3	72,9	84	148,9	108,2	44	197,4	143,4
5	04,0	02,9	65	52,6	38,2	25	101,1	73,5	85	149,7	108,7	45	198,2	144,0
6	04,9	03,5	66	53,4	38,8	26	101,9	74,1	86	150,5	109,3	46	199,0	144,6
7	05,7	04,1	67	54,2	39,4	27	102,7	74,7	87	151,3	109,9	47	199,8	145,2
8	06,5	04,7	68	55,0	40,0	28	103,6	75,2	88	152,1	110,5	48	200,6	145,8
9	07,3	05,3	69	55,8	40,6	29	104,4	75,8	89	152,9	111,1	49	201,4	146,4
10	08,1	05,9	70	56,6	41,1	30	105,2	76,4	90	153,7	111,7	50	202,2	146,9
11	08,9	06,5	71	57,4	41,7	31	106,0	77,0	91	154,5	112,3	51	203,1	147,5
12	09,7	07,1	72	58,2	42,3	32	106,8	77,6	92	155,3	112,9	52	203,9	148,1
13	10,5	07,6	73	59,1	42,9	33	107,6	78,2	93	156,1	113,4	53	204,7	148,7
14	11,3	08,2	74	59,9	43,5	34	108,4	78,8	94	156,9	114,0	54	205,5	149,3
15	12,1	08,8	75	60,7	44,1	35	109,2	79,4	95	157,8	114,6	55	206,3	149,9
16	12,9	09,4	76	61,5	44,7	36	110,0	79,9	96	158,6	115,2	56	207,1	150,5
17	13,8	10,0	77	62,3	45,3	37	110,8	80,5	97	159,4	115,8	57	207,9	151,1
18	14,6	10,6	78	63,1	45,9	38	111,6	81,1	98	160,2	116,4	58	208,7	151,7
19	15,4	11,2	79	63,9	46,4	39	112,5	81,7	99	161,0	117,0	59	209,5	152,2
20	16,2	11,8	80	64,7	47,0	40	113,3	82,3	200	161,8	117,6	60	210,3	152,8
21	17,0	12,4	81	65,5	47,6	41	114,1	82,9	201	162,6	118,1	251	211,1	153,4
22	17,8	12,9	82	66,3	48,2	42	114,9	83,5	02	163,4	118,7	62	212,0	154,0
23	18,6	13,5	83	67,1	48,8	43	115,7	84,1	03	164,2	119,3	63	212,8	154,6
24	19,4	14,1	84	68,0	49,4	44	116,5	84,6	04	165,0	119,9	64	213,6	155,2
25	20,2	14,7	85	68,8	50,0	45	117,3	85,2	05	165,8	120,5	65	214,4	155,8
26	21,0	15,3	86	69,6	50,6	46	118,1	85,8	06	166,7	121,1	66	215,2	156,4
27	21,8	15,9	87	70,4	51,1	47	118,9	86,4	07	167,5	121,7	67	216,0	156,9
28	22,7	16,5	88	71,2	51,7	48	119,7	87,0	08	168,3	122,3	68	216,8	157,5
29	23,5	17,0	89	72,0	52,3	49	120,5	87,6	09	169,1	122,8	69	217,6	158,1
30	24,3	17,6	90	72,8	52,9	50	121,3	88,2	10	169,9	123,4	70	218,4	158,7
31	25,1	18,2	91	73,6	53,5	51	122,2	88,8	211	170,7	124,0	271	219,2	159,3
32	25,9	18,8	92	74,4	54,1	52	123,0	89,3	12	171,5	124,6	72	220,0	159,9
33	26,7	19,4	93	75,2	54,7	53	123,8	89,9	13	172,3	125,2	73	220,9	160,5
34	27,5	20,0	94	76,0	55,3	54	124,6	90,5	14	173,1	125,8	74	221,7	161,1
35	28,3	20,6	95	76,9	55,8	55	125,4	91,1	15	173,9	126,4	75	222,5	161,6
36	29,1	21,2	96	77,7	56,4	56	126,2	91,7	16	174,7	127,0	76	223,3	162,2
37	29,9	21,7	97	78,5	57,0	57	127,0	92,3	17	175,6	127,6	77	224,1	162,8
38	30,7	22,3	98	79,3	57,6	58	127,8	92,9	18	176,4	128,1	78	224,9	163,4
39	31,6	22,9	99	80,1	58,2	59	128,6	93,5	19	177,2	128,7	79	225,7	164,0
40	32,4	23,5	100	80,9	58,8	60	129,4	94,0	20	178,0	129,3	80	226,5	164,6
41	33,2	24,1	101	81,7	59,4	61	130,2	94,6	221	178,8	129,9	281	227,3	165,2
42	34,0	24,7	02	82,5	60,0	62	131,1	95,2	22	179,6	130,5	82	228,1	165,8
43	34,8	25,3	03	83,3	60,5	63	131,9	95,8	23	180,4	131,1	83	228,9	166,3
44	35,6	25,9	04	84,1	61,1	64	132,7	96,4	24	181,2	131,7	84	229,8	166,9
45	36,4	26,5	05	84,9	61,7	65	133,5	97,0	25	182,0	132,3	85	230,6	167,5
46	37,2	27,0	06	85,8	62,3	66	134,3	97,6	26	182,8	132,8	86	231,4	168,1
47	38,0	27,6	07	86,6	62,9	67	135,1	98,2	27	183,6	133,4	87	232,2	168,7
48	38,8	28,2	08	87,4	63,5	68	135,9	98,7	28	184,5	134,0	88	233,0	169,3
49	39,6	28,8	09	88,2	64,1	69	136,7	99,3	29	185,3	134,6	89	233,8	169,9
50	40,5	29,4	10	89,0	64,7	70	137,5	99,9	30	186,1	135,2	90	234,6	170,5
51	41,3	30,0	111	89,8	65,2	71	138,3	100,5	231	186,9	135,8	291	235,4	171,0
52	42,1	30,6	12	90,6	65,8	72	139,1	101,1	32	187,7	136,4	92	236,2	171,6
53	42,9	31,2	13	91,4	66,4	73	140,0	101,7	33	188,5	137,0	93	237,0	172,2
54	43,7	31,7	14	92,2	67,0	74	140,8	102,3	34	189,3	137,5	94	237,8	172,8
55	44,5	32,3	15	93,0	67,6	75	141,6	102,9	35	190,1	138,1	95	238,7	173,4
56	45,3	32,9	16	93,8	68,2	76	142,4	103,5	36	190,9	138,7	96	239,5	174,0
57	46,1	33,5	17	94,7	68,8	77	143,2	104,0	37	191,7	139,3	97	240,3	174,6
58	46,9	34,1	18	95,5	69,4	78	144,0	104,6	38	192,5	139,9	98	241,1	175,2
59	47,7	34,7	19	96,3	69,9	79	144,8	105,2	39	193,3	140,5	99	241,9	175,7
60	48,5	35,3	20	97,1	70,5	80	145,6	105,8	40	194,2	141,1	300	242,7	176,3
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 54 Deg.

Difference of Latitude and Departure for 37 Deg.

Diff.	Lat.	Dep.	Diff.	Lat.	Dep.	Diff.	Lat.	Dep.	Diff.	Lat.	Dep.	Diff.	Lat.	Dep.	Diff.	Lat.	Dep.
1	00,8	00,6	61	48,7	36,7	121	96,6	72,8	181	144,5	108,9	241	192,5	145,0	301	240,4	151,0
2	01,6	01,2	62	49,5	37,3	22	97,4	73,4	82	145,3	109,5	42	193,3	145,6	31	201,2	151,6
3	02,4	01,8	63	50,3	37,9	23	98,2	74,0	83	146,1	110,1	43	194,1	146,2	32	202,0	152,2
4	03,2	02,4	64	51,1	38,5	24	99,0	74,6	84	146,9	110,7	44	194,9	146,8	33	202,8	152,9
5	04,0	03,0	65	51,9	39,1	25	99,8	75,2	85	147,7	111,3	45	195,7	147,4	34	203,6	153,5
6	04,8	03,6	66	52,7	39,7	26	100,6	75,8	86	148,5	111,9	46	196,5	148,0	35	204,4	154,1
7	05,6	04,2	67	53,5	40,3	27	101,4	76,4	87	149,3	112,5	47	197,3	148,6	36	205,2	154,7
8	06,4	04,8	68	54,3	40,9	28	102,2	77,0	88	150,1	113,1	48	198,1	149,2	37	206,0	155,3
9	07,2	05,4	69	55,1	41,5	29	103,0	77,6	89	150,9	113,7	49	198,9	149,8	38	206,8	155,9
10	08,0	06,0	70	55,9	42,1	30	103,8	78,2	90	151,7	114,3	50	199,7	150,4	39	207,6	156,5
11	08,8	06,6	71	56,7	42,7	31	104,6	78,8	191	152,5	114,9	251	200,4	151,0	40	208,4	157,1
12	09,6	07,2	72	57,5	43,3	32	105,4	79,4	92	153,3	115,5	52	201,2	151,6	41	209,2	157,7
13	10,4	07,8	73	58,3	43,9	33	106,2	80,0	93	154,1	116,1	53	202,0	152,2	42	210,0	158,3
14	11,2	08,4	74	59,1	44,5	34	107,0	80,6	94	154,9	116,7	54	202,8	152,9	43	210,8	158,9
15	12,0	09,0	75	59,9	45,1	35	107,8	81,2	95	155,7	117,3	55	203,6	153,5	44	211,6	159,5
16	12,8	09,6	76	60,7	45,7	36	108,6	81,8	96	156,5	117,9	56	204,4	154,1	45	212,4	160,1
17	13,6	10,2	77	61,5	46,3	37	109,4	82,4	97	157,3	118,6	57	205,2	154,7	46	213,2	160,7
18	14,4	10,8	78	62,3	46,9	38	110,2	83,0	98	158,1	119,2	58	206,0	155,3	47	214,0	161,3
19	15,2	11,4	79	63,1	47,5	39	111,0	83,6	99	158,9	119,8	59	206,8	155,9	48	214,8	161,9
20	16,0	12,0	80	63,9	48,1	40	111,8	84,2	200	159,7	120,4	60	207,6	156,5	49	215,6	162,5
21	16,8	12,6	81	64,7	48,7	141	112,6	84,9	201	160,5	121,0	261	208,4	157,1	50	216,4	163,1
22	17,6	13,2	82	65,5	49,3	42	113,4	85,5	02	161,3	121,6	62	209,2	157,7	51	217,2	163,7
23	18,4	13,8	83	66,3	49,9	43	114,2	86,1	03	162,1	122,2	63	210,0	158,3	52	218,0	164,3
24	19,2	14,4	84	67,1	50,6	44	115,0	86,7	04	162,9	122,8	64	210,8	158,9	53	218,8	164,9
25	20,0	15,0	85	67,9	51,2	45	115,8	87,3	05	163,7	123,4	65	211,6	159,5	54	219,6	165,5
26	20,8	15,6	86	68,7	51,8	46	116,6	87,9	06	164,5	124,0	66	212,4	160,1	55	220,4	166,1
27	21,6	16,2	87	69,5	52,4	47	117,4	88,5	07	165,3	124,6	67	213,2	160,7	56	221,2	166,7
28	22,4	16,9	88	70,3	53,0	48	118,2	89,1	08	166,1	125,2	68	214,0	161,3	57	222,0	167,3
29	23,2	17,5	89	71,1	53,6	49	119,0	89,7	09	166,9	125,8	69	214,8	161,9	58	222,8	167,9
30	24,0	18,1	90	71,9	54,2	50	119,8	90,3	10	167,7	126,4	70	215,6	162,5	59	223,6	168,5
31	24,8	18,7	91	72,7	54,8	151	120,6	90,9	211	168,5	127,0	271	216,4	163,1	60	224,4	169,1
32	25,6	19,3	92	73,5	55,4	52	121,4	91,5	12	169,3	127,6	72	217,2	163,7	61	225,2	169,7
33	26,4	19,9	93	74,3	56,0	53	122,2	92,1	13	170,1	128,2	73	218,0	164,3	62	226,0	170,3
34	27,2	20,5	94	75,1	56,6	54	123,0	92,7	14	170,9	128,8	74	218,8	164,9	63	226,8	170,9
35	28,0	21,1	95	75,9	57,2	55	123,8	93,3	15	171,7	129,4	75	219,6	165,5	64	227,6	171,5
36	28,8	21,7	96	76,7	57,8	56	124,6	93,9	16	172,5	130,0	76	220,4	166,1	65	228,4	172,1
37	29,6	22,3	97	77,5	58,4	57	125,4	94,5	17	173,3	130,6	77	221,2	166,7	66	229,2	172,7
38	30,4	22,9	98	78,3	59,0	58	126,2	95,1	18	174,1	131,2	78	222,0	167,3	67	230,0	173,3
39	31,2	23,5	99	79,1	59,6	59	127,0	95,7	19	174,9	131,8	79	222,8	167,9	68	230,8	173,9
40	31,9	24,1	100	79,9	60,2	60	127,8	96,3	20	175,7	132,4	80	223,6	168,5	69	231,6	174,5
41	32,7	24,7	101	80,7	60,8	161	128,6	96,9	221	176,5	133,0	281	224,4	169,1	70	232,4	175,1
42	33,5	25,3	02	81,5	61,4	62	129,4	97,5	22	177,3	133,6	82	225,2	169,7	71	233,2	175,7
43	34,3	25,9	03	82,3	62,0	63	130,2	98,1	23	178,1	134,2	83	226,0	170,3	72	234,0	176,3
44	35,1	26,5	04	83,1	62,6	64	131,0	98,7	24	178,9	134,8	84	226,8	170,9	73	234,8	176,9
45	35,9	27,1	05	83,9	63,2	65	131,8	99,3	25	179,7	135,4	85	227,6	171,5	74	235,6	177,5
46	36,7	27,7	06	84,7	63,8	66	132,6	99,9	26	180,5	136,0	86	228,4	172,1	75	236,4	178,1
47	37,5	28,3	07	85,5	64,4	67	133,4	100,5	27	181,3	136,6	87	229,2	172,7	76	237,2	178,7
48	38,3	28,9	08	86,3	65,0	68	134,2	101,1	28	182,1	137,2	88	230,0	173,3	77	238,0	179,3
49	39,1	29,5	09	87,1	65,6	69	135,0	101,7	29	182,9	137,8	89	230,8	173,9	78	238,8	179,9
50	39,9	30,1	10	87,9	66,2	70	135,8	102,3	30	183,7	138,4	90	231,6	174,5	79	239,6	180,5
51	40,7	30,7	111	88,6	66,8	171	136,6	102,9	231	184,5	139,0	291	232,4	175,1	80	240,4	181,1
52	41,5	31,3	12	89,4	67,4	72	137,4	103,5	32	185,3	139,6	92	233,2	175,7	81	241,2	181,7
53	42,3	31,9	13	90,2	68,0	73	138,2	104,1	33	186,1	140,2	93	234,0	176,3	82	242,0	182,3
54	43,1	32,5	14	91,0	68,6	74	139,0	104,7	34	186,9	140,8	94	234,8	176,9	83	242,8	182,9
55	43,9	33,1	15	91,8	69,2	75	139,8	105,3	35	187,7	141,4	95	235,6	177,5	84	243,6	183,5
56	44,7	33,7	16	92,6	69,8	76	140,6	105,9	36	188,5	142,0	96	236,4	178,1	85	244,4	184,1
57	45,5	34,3	17	93,4	70,4	77	141,4	106,5	37	189,3	142,6	97	237,2	178,7	86	245,2	184,7
58	46,3	34,9	18	94,2	71,0	78	142,2	107,1	38	190,1	143,2	98	238,0	179,3	87	246,0	185,3
59	47,1	35,5	19	95,0	71,6	79	142,9	107,7	39	190,9	143,8	99	238,8	179,9	88	246,8	185,9
60	47,9	36,1	20	95,8	72,2	80	143,7	108,3	40	191,7	144,4	100	239,6	180,5	89	247,6	186,5
Diff.	Dep.	Lat.	Diff.	Dep.	Lat.	Diff.	Dep.	Lat.	Diff.	Dep.	Lat.	Diff.	Dep.	Lat.	Diff.	Dep.	Lat.

for 53 Deg.

Difference of Latitude and Departure for 38 Deg.

D. ft.	Lat.	Dep.	D. ft.	Lat.	Dep.	D. ft.	Lat.	Dep.	D. ft.	Lat.	Dep.	D. ft.	Lat.	Dep.
1	00,8	00,6	61	48,1	37,6	121	95,3	74,3	181	142,1	111,4	241	189,9	148,4
2	01,6	01,2	62	48,9	38,2	22	96,1	75,1	82	143,4	112,1	42	190,7	149,0
3	02,4	01,6	63	49,6	38,8	23	96,9	75,7	83	144,2	112,7	43	191,5	149,6
4	03,2	02,5	64	50,4	39,4	24	97,7	76,3	84	145,0	113,3	44	192,2	150,2
5	03,9	03,1	65	51,2	40,0	25	98,5	77,0	85	145,8	113,9	45	193,0	150,8
6	04,7	03,7	66	52,0	40,6	26	99,3	77,6	86	146,5	114,5	46	193,8	151,5
7	05,5	04,3	67	52,8	41,3	27	100,1	78,2	87	147,3	115,1	47	194,6	152,1
8	06,3	04,9	68	53,6	41,9	28	100,9	78,8	88	148,1	115,8	48	195,4	152,7
9	07,1	05,5	69	54,4	42,5	29	101,6	79,4	89	148,9	116,4	49	196,2	153,3
10	07,9	06,2	70	55,2	43,1	30	102,4	80,0	90	149,7	117,0	50	197,0	153,9
11	08,7	06,8	71	55,9	43,7	31	103,2	80,7	191	150,5	117,6	251	197,8	154,5
12	09,5	07,4	72	56,7	44,3	32	104,0	81,3	92	151,3	118,2	52	198,5	155,2
13	10,2	08,0	73	57,5	44,9	33	104,8	81,9	93	152,1	118,8	53	199,3	155,8
14	11,0	08,6	74	58,3	45,5	34	105,6	82,5	94	152,9	119,4	54	200,1	156,4
15	11,8	09,2	75	59,1	46,2	35	106,4	83,1	95	153,6	120,1	55	200,9	157,0
16	12,6	09,9	76	59,9	46,8	36	107,2	83,7	96	154,4	120,7	56	201,7	157,6
17	13,4	10,5	77	60,7	47,4	37	107,9	84,4	97	155,2	121,3	57	202,5	158,2
18	14,2	11,1	78	61,5	48,0	38	108,7	85,0	98	156,0	121,9	58	203,3	158,9
19	15,0	11,7	79	62,3	48,6	39	109,5	85,6	99	156,8	122,5	59	204,1	159,5
20	15,8	12,3	80	63,0	49,3	40	110,3	86,2	200	157,6	123,1	60	204,9	160,1
21	16,5	12,9	81	63,8	49,9	41	111,1	86,8	201	158,4	123,8	261	205,6	160,7
22	17,3	13,5	82	64,6	50,5	42	111,9	87,4	02	159,2	124,4	62	206,4	161,3
23	18,1	14,2	83	65,4	51,1	43	112,7	88,0	03	159,9	125,0	63	207,2	161,9
24	18,9	14,8	84	66,2	51,7	44	113,5	88,7	04	160,7	125,6	64	208,0	162,5
25	19,7	15,4	85	67,0	52,3	45	114,2	89,3	05	161,5	126,2	65	208,8	163,2
26	20,5	16,0	86	67,8	53,0	46	115,0	89,9	06	162,3	126,8	66	209,6	163,8
27	21,3	16,6	87	68,5	53,6	47	115,8	90,5	07	163,1	127,4	67	210,4	164,4
28	22,1	17,2	88	69,3	54,2	48	116,6	91,1	08	163,9	128,1	68	211,2	165,0
29	22,9	17,9	89	70,1	54,8	49	117,4	91,7	09	164,7	128,7	69	211,9	165,6
30	23,6	18,5	90	70,9	55,4	50	118,2	92,4	10	165,5	129,3	70	212,7	166,2
31	24,4	19,1	91	71,7	56,0	151	119,0	93,0	211	166,2	129,9	271	213,5	166,9
32	25,2	19,7	92	72,5	56,6	52	119,8	93,6	12	167,0	130,5	72	214,3	167,5
33	26,0	20,3	93	73,3	57,3	53	120,5	94,2	13	167,8	131,1	73	215,1	168,1
34	26,8	20,9	94	74,1	57,9	54	121,3	94,8	14	168,6	131,8	74	215,9	168,7
35	27,6	21,5	95	74,9	58,5	55	122,1	95,4	15	169,4	132,4	75	216,7	169,3
36	28,4	22,2	96	75,6	59,1	56	122,9	96,0	16	170,2	133,0	76	217,5	169,9
37	29,2	22,8	97	76,4	59,7	57	123,7	96,7	17	171,0	133,6	77	218,2	170,5
38	29,9	23,4	98	77,2	60,3	58	124,5	97,3	18	171,8	134,2	78	219,0	171,2
39	30,7	24,0	99	78,0	61,0	59	125,3	97,9	19	172,5	134,8	79	219,8	171,8
40	31,5	24,6	100	78,8	61,6	60	126,1	98,5	20	173,3	135,5	80	220,6	172,4
41	32,3	25,2	101	79,6	62,2	161	126,9	99,1	221	174,1	136,1	231	221,4	173,0
42	33,1	25,9	02	80,4	62,8	62	127,6	99,7	22	174,9	136,7	82	222,2	173,6
43	33,9	26,5	03	81,2	63,4	63	128,4	100,4	23	175,7	137,3	83	223,0	174,2
44	34,7	27,1	04	81,9	64,0	64	129,2	101,0	24	176,5	137,9	84	223,8	174,8
45	35,5	27,7	05	82,7	64,6	65	130,0	101,6	25	177,3	138,5	85	224,5	175,5
46	36,2	28,3	06	83,5	65,3	66	130,8	102,2	26	178,1	139,1	86	225,3	176,1
47	37,0	28,9	07	84,3	65,9	67	131,6	102,8	27	178,9	139,8	87	226,1	176,7
48	37,8	29,6	08	85,1	66,5	68	132,4	103,4	28	179,6	140,4	88	226,9	177,3
49	38,6	30,2	09	85,9	67,1	69	133,2	104,1	29	180,4	141,0	89	227,7	177,9
50	39,4	30,8	10	86,7	67,7	70	133,9	104,7	30	181,2	141,6	90	228,5	178,6
51	40,2	31,4	111	87,5	68,3	171	134,7	105,3	231	182,0	142,2	291	229,3	179,2
52	41,0	32,0	12	88,2	69,0	72	135,5	105,9	32	182,8	142,8	92	230,1	179,8
53	41,8	32,6	13	89,0	69,6	73	136,3	106,5	33	183,6	143,5	93	230,9	180,4
54	42,5	33,2	14	89,8	70,2	74	137,1	107,1	34	184,4	144,1	94	231,6	181,0
55	43,3	33,9	15	90,6	70,8	75	137,9	107,7	35	185,2	144,7	95	232,4	181,6
56	44,1	34,5	16	91,4	71,4	76	138,7	108,4	36	185,9	145,3	96	233,2	182,2
57	44,9	35,1	17	92,2	72,0	77	139,5	109,0	37	186,7	145,9	97	234,0	182,9
58	45,7	35,7	18	93,0	72,7	78	140,2	109,6	38	187,5	146,5	98	234,8	183,5
59	46,5	36,3	19	93,8	73,3	79	141,0	110,2	39	188,3	147,2	99	235,6	184,1
60	47,3	36,9	20	94,5	73,9	80	141,8	110,8	40	189,1	147,8	300	236,4	184,7
D. ft.	Lat.	Dep.	D. ft.	Lat.	Dep.	D. ft.	Lat.	Dep.	D. ft.	Lat.	Dep.	D. ft.	Lat.	Dep.

for 52 Deg.

Difference of Latitude and Departure for 39 Deg.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00,8	00,6	61	47,4	38,4	121	94,0	76,1	181	140,7	113,9	241	187,3	151,7
2	01,6	01,3	62	48,2	39,0	22	94,8	76,8	82	141,4	114,5	42	188,1	152,3
3	02,3	01,9	63	49,0	39,6	23	95,6	77,4	83	142,2	115,2	43	188,8	152,9
4	03,1	02,5	64	49,7	40,3	24	96,4	78,0	84	143,0	115,8	44	189,6	153,6
5	03,9	03,1	65	50,5	40,9	25	97,1	78,7	85	143,8	116,4	45	190,4	154,2
6	04,7	03,8	66	51,3	41,5	26	97,9	79,3	86	144,5	117,1	46	191,2	154,8
7	05,4	04,4	67	52,1	42,2	27	98,7	79,9	87	145,3	117,7	47	191,9	155,4
8	06,2	05,0	68	52,8	42,8	28	99,5	80,6	88	146,1	118,3	48	192,7	156,1
9	07,0	05,7	69	53,6	43,4	29	100,2	81,2	89	146,9	118,9	49	193,5	156,7
10	07,8	06,3	70	54,4	44,1	30	101,0	81,8	90	147,6	119,6	50	194,3	157,3
11	08,5	06,9	71	55,2	44,7	31	101,8	82,4	191	148,4	120,2	251	195,1	158,0
12	09,3	07,6	72	56,0	45,3	32	102,6	83,1	92	149,2	120,8	52	195,8	158,6
13	10,1	08,2	73	56,7	45,9	33	103,4	83,7	93	150,0	121,5	53	196,6	159,2
14	10,9	08,8	74	57,5	46,6	34	104,1	84,3	94	150,8	122,1	54	197,4	159,8
15	11,7	09,4	75	58,3	47,2	35	104,9	85,0	95	151,5	122,7	55	198,2	160,5
16	12,4	10,1	76	59,1	47,8	36	105,7	85,6	96	152,3	123,3	56	198,9	161,1
17	13,2	10,7	77	59,8	48,5	37	106,5	86,2	97	153,1	124,0	57	199,7	161,7
18	14,0	11,3	78	60,6	49,1	38	107,2	86,8	98	153,9	124,6	58	200,5	162,4
19	14,8	12,0	79	61,4	49,7	39	108,0	87,5	99	154,6	125,2	59	201,3	163,0
20	15,5	12,6	80	62,2	50,3	40	108,8	88,1	200	155,4	125,9	60	202,0	163,6
21	16,3	13,2	81	62,9	51,0	141	109,0	88,7	201	156,2	126,5	261	202,8	164,2
22	17,1	13,8	82	63,7	51,6	42	110,3	89,4	02	157,0	127,1	62	203,6	164,9
23	17,9	14,5	83	64,5	52,2	43	111,1	90,0	03	157,8	127,7	63	204,4	165,5
24	18,7	15,1	84	65,3	52,9	44	111,9	90,6	04	158,5	128,4	64	205,2	166,1
25	19,4	15,7	85	66,1	53,5	45	112,7	91,2	05	159,3	129,0	65	205,9	166,8
26	20,2	16,4	86	66,8	54,1	46	113,5	91,9	06	160,1	129,6	66	206,7	167,4
27	21,0	17,0	87	67,6	54,7	47	114,2	92,5	07	160,9	130,3	67	207,5	168,0
28	21,8	17,6	88	68,4	55,4	48	115,0	93,1	08	161,6	130,9	68	208,3	168,7
29	22,5	18,2	89	69,2	56,0	49	115,8	93,8	09	162,4	131,5	69	209,0	169,3
30	23,3	18,9	90	69,9	56,6	50	116,6	94,4	10	163,2	132,2	70	209,8	169,9
31	24,1	19,5	91	70,7	57,3	151	117,3	95,0	211	164,0	132,8	271	210,6	170,5
32	24,9	20,1	92	71,5	57,9	52	118,1	95,7	12	164,7	133,4	72	211,4	171,2
33	25,6	20,8	93	72,3	58,5	53	118,9	96,3	13	165,5	134,0	73	212,1	171,8
34	26,4	21,4	94	73,0	59,2	54	119,7	96,9	14	166,3	134,7	74	212,9	172,4
35	27,2	22,0	95	73,8	59,8	55	120,5	97,5	15	167,1	135,3	75	213,7	173,1
36	28,0	22,7	96	74,6	60,4	56	121,2	98,2	16	167,9	135,9	76	214,5	173,7
37	28,8	23,3	97	75,4	61,0	57	122,0	98,8	17	168,6	136,6	77	215,3	174,3
38	29,5	23,9	98	76,2	61,7	58	122,8	99,4	18	169,4	137,2	78	216,0	174,9
39	30,3	24,5	99	76,9	62,3	59	123,6	100,1	19	170,2	137,8	79	216,8	175,6
40	31,1	25,2	100	77,7	62,9	60	124,3	100,7	20	171,0	138,4	80	217,6	176,2
41	31,9	25,8	101	78,5	63,6	161	125,1	101,3	221	171,7	139,1	281	218,4	176,8
42	32,6	26,4	02	79,3	64,2	62	125,9	101,9	22	172,5	139,7	82	219,1	177,5
43	33,4	27,1	03	80,0	64,8	63	126,7	102,6	23	173,3	140,3	83	219,9	178,1
44	34,2	27,7	04	80,8	65,4	64	127,4	103,2	24	174,1	141,0	84	220,7	178,7
45	35,0	28,3	05	81,6	66,1	65	128,2	103,8	25	174,8	141,6	85	221,5	179,4
46	35,7	28,9	06	82,4	66,7	66	129,0	104,5	26	175,6	142,2	86	222,3	180,0
47	36,5	29,6	07	83,1	67,3	67	129,8	105,1	27	176,4	142,9	87	223,0	180,6
48	37,3	30,2	08	83,9	68,0	68	130,6	105,7	28	177,2	143,5	88	223,8	181,2
49	38,1	30,8	09	84,7	68,6	69	131,3	106,4	29	178,0	144,1	89	224,6	181,9
50	38,9	31,5	10	85,5	69,2	70	132,1	107,0	30	178,7	144,7	90	225,4	182,5
51	39,6	32,1	111	86,3	69,9	171	132,9	107,6	231	179,5	145,4	291	226,1	183,1
52	40,4	32,7	12	87,0	70,5	72	133,7	108,2	32	180,3	146,0	92	226,9	183,8
53	41,2	33,4	13	87,8	71,1	73	134,4	108,9	33	181,1	146,6	93	227,7	184,4
54	42,0	34,0	14	88,6	71,7	74	135,2	109,5	34	181,8	147,3	94	228,5	185,0
55	42,7	34,6	15	89,4	72,4	75	136,0	110,1	35	182,6	147,9	95	229,2	185,6
56	43,5	35,2	16	90,1	73,0	76	136,8	110,8	36	183,4	148,5	96	230,0	186,3
57	44,3	35,9	17	90,9	73,6	77	137,5	111,4	37	184,2	149,1	97	230,8	186,9
58	45,1	36,5	18	91,7	74,3	78	138,3	112,0	38	185,0	149,8	98	231,6	187,5
59	45,8	37,1	19	92,5	74,9	79	139,1	112,6	39	185,7	150,4	99	232,4	188,2
60	46,6	37,8	20	93,3	75,5	80	139,9	113,3	40	186,5	151,0	300	233,1	188,8
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 51 Deg.

Difference of Latitude and Departure for 40 Deg.

Diff.	Lat.	Dep.	Diff.	Lat.	Dep.	Diff.	Lat.	Dep.	Diff.	Lat.	Dep.	Diff.	Lat.	Dep.
1	00,8	00,6	61	46,7	39,2	121	92,7	77,8	181	138,6	116,4	241	184,6	154,9
2	01,5	01,3	62	47,5	39,9	22	93,4	78,4	82	139,4	117,0	42	185,4	155,6
3	02,3	01,9	63	48,3	40,5	23	94,2	79,1	83	140,2	117,6	43	186,1	156,2
4	03,1	02,6	64	49,0	41,1	24	95,0	79,7	84	140,9	118,3	44	186,9	156,9
5	03,8	03,2	65	49,8	41,8	25	95,7	80,4	85	141,7	118,9	45	187,7	157,5
6	04,6	03,9	66	50,6	42,4	26	96,5	81,0	86	142,5	119,6	46	188,4	158,1
7	05,4	04,5	67	51,3	43,1	27	97,3	81,6	87	143,2	120,2	47	189,2	158,8
8	06,1	05,1	68	52,1	43,7	28	98,0	82,3	88	144,0	120,9	48	190,0	159,4
9	06,9	05,8	69	52,9	44,4	29	98,8	82,9	89	144,8	121,5	49	190,7	160,1
10	07,7	06,4	70	53,6	45,0	30	99,6	83,6	90	145,5	122,1	50	191,5	160,7
11	08,4	07,1	71	54,4	45,6	31	100,3	84,2	91	146,3	122,8	51	192,3	161,4
12	09,2	07,7	72	55,2	46,3	32	101,1	84,9	92	147,1	123,4	52	193,0	162,~
13	10,0	08,4	73	55,9	46,9	33	101,9	85,5	93	147,8	124,1	53	193,8	162,6
14	10,7	09,0	74	56,7	47,6	34	102,6	86,1	94	148,6	124,7	54	194,6	163,3
15	11,5	09,6	75	57,4	48,2	35	103,4	86,8	95	149,4	125,4	55	195,3	163,9
16	12,3	10,3	76	58,2	48,9	36	104,2	87,4	96	150,1	126,0	56	196,1	164,6
17	13,0	10,9	77	59,0	49,5	37	104,9	88,1	97	150,9	126,6	57	196,9	165,2
18	13,8	11,6	78	59,7	50,1	38	105,7	88,7	98	151,7	127,3	58	197,6	165,9
19	14,6	12,2	79	60,5	50,8	39	106,5	89,4	99	152,4	127,9	59	198,4	166,5
20	15,3	12,9	80	61,3	51,4	40	107,2	90,0	200	153,2	128,6	60	199,2	167,1
21	16,1	13,5	81	62,0	52,1	41	108,0	90,6	201	154,0	129,2	261	199,9	167,8
22	16,9	14,1	82	62,8	52,7	42	108,8	91,3	02	154,7	129,9	62	200,7	168,4
23	17,6	14,8	83	63,6	53,4	43	109,5	91,9	03	155,5	130,5	63	201,4	169,1
24	18,4	15,4	84	64,3	54,0	44	110,3	92,6	04	156,3	131,1	64	202,2	169,7
25	19,2	16,1	85	65,1	54,6	45	111,1	93,2	05	157,0	131,8	65	203,0	170,4
26	19,9	16,7	86	65,9	55,3	46	111,8	93,9	06	157,8	132,4	66	203,7	171,0
27	20,7	17,4	87	66,6	55,9	47	112,6	94,5	07	158,6	133,1	67	204,5	171,6
28	21,4	18,0	88	67,4	56,6	48	113,4	95,1	08	159,3	133,7	68	205,3	172,3
29	22,2	18,6	89	68,2	57,2	49	114,1	95,8	09	160,1	134,4	69	206,0	172,9
30	23,0	19,3	90	68,9	57,9	50	114,9	96,4	10	160,9	135,0	70	206,8	173,6
31	23,7	19,9	91	69,7	58,5	151	115,7	97,1	211	161,6	135,6	271	207,6	174,2
32	24,5	20,6	92	70,5	59,1	52	116,4	97,7	12	162,4	136,3	72	208,3	174,8
33	25,3	21,2	93	71,2	59,8	53	117,2	98,4	13	163,2	136,9	73	209,1	175,5
34	26,0	21,9	94	72,0	60,4	54	118,0	99,0	14	163,9	137,6	74	209,9	176,1
35	26,8	22,5	95	72,8	61,1	55	118,7	99,6	15	164,7	138,2	75	210,6	176,8
36	27,6	23,1	96	73,5	61,7	56	119,5	100,3	16	165,4	138,8	76	211,4	177,4
37	28,3	23,8	97	74,3	62,4	57	120,3	100,9	17	166,2	139,5	77	212,2	178,1
38	29,1	24,4	98	75,1	63,0	58	121,0	101,6	18	167,0	140,1	78	212,9	178,7
39	29,9	25,1	99	75,8	63,6	59	121,8	102,2	19	167,7	140,8	79	213,7	179,3
40	30,6	25,7	100	76,6	64,3	60	122,6	102,8	20	168,5	141,4	80	214,5	180,0
41	31,4	26,4	101	77,4	64,9	161	123,3	103,5	221	169,3	142,1	281	215,2	180,6
42	32,2	27,0	02	78,1	65,6	62	124,1	104,1	22	170,0	142,7	82	216,0	181,3
43	32,9	27,6	03	78,9	66,2	63	124,9	104,8	23	170,8	143,3	83	216,8	181,9
44	33,7	28,3	04	79,7	66,8	64	125,6	105,4	24	171,6	144,0	84	217,5	182,6
45	34,5	28,9	05	80,4	67,5	65	126,4	106,1	25	172,3	144,6	85	218,3	183,2
46	35,2	29,6	06	81,2	68,1	66	127,2	106,7	26	173,1	145,3	86	219,1	183,9
47	36,0	30,2	07	82,0	68,8	67	127,9	107,3	27	173,9	145,9	87	219,8	184,5
48	36,8	30,8	08	82,7	69,4	68	128,7	108,0	28	174,6	146,6	88	220,6	185,1
49	37,5	31,5	09	83,5	70,1	69	129,4	108,6	29	175,4	147,2	89	221,4	185,8
50	38,3	32,1	10	84,3	70,7	70	130,2	109,3	30	176,2	147,9	90	222,2	186,4
51	39,1	32,8	111	85,0	71,3	171	131,0	109,9	231	176,9	148,5	291	222,9	187,1
52	39,8	33,4	12	85,8	72,0	72	131,7	110,6	32	177,7	149,1	92	223,7	187,7
53	40,6	34,1	13	86,6	72,6	73	132,5	111,2	33	178,5	149,8	93	224,4	188,4
54	41,4	34,7	14	87,3	73,3	74	133,3	111,9	34	179,2	150,4	94	225,2	189,0
55	42,1	35,3	15	88,1	73,9	75	134,0	112,5	35	180,0	151,1	95	226,0	189,6
56	42,9	36,0	16	88,9	74,6	76	134,8	113,1	36	180,8	151,7	96	226,7	190,3
57	43,7	36,6	17	89,6	75,2	77	135,6	113,8	37	181,5	152,4	97	227,5	190,9
58	44,4	37,3	18	90,4	75,9	78	136,3	114,4	38	182,3	153,0	98	228,3	191,6
59	45,2	37,9	19	91,2	76,5	79	137,1	115,1	39	183,1	153,6	99	229,0	192,2
60	46,0	38,6	20	91,9	77,1	80	137,9	115,7	40	183,8	154,3	300	229,8	192,9
Diff.	Dep.	Lat.	Diff.	Dep.	Lat.	Diff.	Dep.	Lat.	Diff.	Dep.	Lat.	Diff.	Dep.	Lat.

for 50 Deg.

Difference of Latitude and Departure for 41 Deg.

Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.
1	00,8	00,7	61	46,0	40,0	121	91,3	79,4	181	136,6	118,7	241	181,9	158,1			
2	01,5	01,3	62	46,8	40,7	22	92,1	80,0	82	137,4	119,4	42	182,6	158,7			
3	02,3	02,0	63	47,5	41,3	23	92,8	80,7	83	138,1	120,0	43	183,4	159,4			
4	03,0	02,6	64	48,3	42,0	24	93,6	81,3	84	138,9	120,7	44	184,2	160,0			
5	03,8	03,3	65	49,1	42,6	25	94,3	82,0	85	139,6	121,4	45	184,9	160,7			
6	04,5	03,9	66	49,8	43,3	26	95,1	82,6	86	140,4	122,0	46	185,7	161,4			
7	05,3	04,6	67	50,6	44,0	27	95,8	83,3	87	141,1	122,7	47	186,4	162,0			
8	06,0	05,2	68	51,3	44,6	28	96,6	84,0	88	141,9	123,3	48	187,2	162,7			
9	06,8	05,9	69	52,1	45,3	29	97,4	84,6	89	142,6	124,0	49	187,9	163,3			
10	07,5	06,6	70	52,8	45,9	30	98,1	85,3	90	143,4	124,6	50	188,7	164,0			
11	08,3	07,2	71	53,6	46,6	131	98,9	85,9	191	144,2	125,3	251	189,4	164,6			
12	09,1	07,9	72	54,3	47,2	32	99,6	86,6	92	144,9	125,9	52	190,2	165,3			
13	09,8	08,5	73	55,1	47,9	33	100,4	87,2	93	145,7	126,6	53	190,9	166,0			
14	10,6	09,2	74	55,8	48,5	34	101,1	87,9	94	146,4	127,3	54	191,7	166,6			
15	11,3	09,8	75	56,6	49,2	35	101,9	88,6	95	147,2	127,9	55	192,5	167,5			
16	12,1	10,5	76	57,4	49,9	36	102,6	89,2	96	147,9	128,6	56	193,2	167,3			
17	12,8	11,2	77	58,1	50,5	37	103,4	89,9	97	148,7	129,2	57	194,0	168,0			
18	13,6	11,8	78	58,9	51,2	38	104,2	90,5	98	149,4	129,9	58	194,7	169,2			
19	14,3	12,5	79	59,6	51,8	39	104,9	91,2	99	150,2	130,5	59	195,5	169,9			
20	15,1	13,1	80	60,4	52,5	40	105,7	91,8	200	150,9	131,2	60	196,2	170,5			
21	15,8	13,8	81	61,1	53,1	141	106,4	92,5	201	151,7	131,8	261	197,0	171,2			
22	16,6	14,4	82	61,9	53,8	42	107,2	93,1	02	152,5	132,5	62	197,7	171,9			
23	17,4	15,1	83	62,6	54,4	43	107,9	93,8	03	153,2	133,2	63	198,5	172,5			
24	18,1	15,7	84	63,4	55,1	44	108,7	94,5	04	154,0	133,8	64	199,2	173,2			
25	18,9	16,4	85	64,2	55,8	45	109,4	95,1	05	154,7	134,5	65	200,0	173,8			
26	19,6	17,1	86	64,9	56,4	46	110,2	95,8	06	155,2	135,1	66	200,8	174,5			
27	20,4	17,7	87	65,7	57,1	47	110,9	96,4	07	156,5	135,8	67	201,5	175,1			
28	21,1	18,4	88	66,4	57,7	48	111,7	97,1	08	157,0	136,4	68	202,3	175,8			
29	21,9	19,0	89	67,2	58,4	49	112,5	97,7	09	157,7	137,1	69	203,0	176,4			
30	22,6	19,7	90	67,9	59,0	50	113,2	98,4	10	158,5	137,7	70	203,8	177,1			
31	23,4	20,3	91	68,7	59,7	151	114,0	99,0	211	158,2	138,4	271	204,5	177,8			
32	24,2	21,0	92	69,4	60,4	52	114,7	99,7	12	160,0	139,1	72	205,3	178,4			
33	24,9	21,6	93	70,2	61,0	53	115,5	100,4	13	160,8	139,7	73	206,0	179,1			
34	25,7	22,3	94	70,9	61,7	54	116,2	101,0	14	161,5	140,4	74	206,8	179,7			
35	26,4	23,0	95	71,7	62,3	55	117,0	101,7	15	162,3	141,0	75	207,5	180,4			
36	27,2	23,6	96	72,5	63,0	56	117,7	102,3	16	163,0	141,7	76	208,3	181,0			
37	27,9	24,3	97	73,2	63,6	57	118,5	102,0	17	163,8	142,3	77	209,1	181,7			
38	28,7	24,9	98	74,0	64,3	58	119,2	103,6	18	164,5	143,0	78	209,8	182,4			
39	29,4	25,6	99	74,7	64,9	59	120,0	104,3	19	165,3	143,6	79	210,6	183,0			
40	30,2	26,2	100	75,5	65,6	60	120,8	105,0	20	166,0	144,3	80	211,3	183,7			
41	30,9	26,9	101	76,2	66,3	161	121,5	105,6	221	166,8	145,0	281	212,1	184,3			
42	31,7	27,6	02	77,0	66,6	62	122,3	106,3	22	167,5	145,6	82	212,8	185,0			
43	32,5	28,2	03	77,7	67,6	63	123,0	106,9	23	168,3	146,3	83	213,6	185,6			
44	33,2	28,9	04	78,5	68,2	64	123,8	107,6	24	169,1	146,9	84	214,3	186,3			
45	34,0	29,5	05	79,2	68,9	65	124,5	108,2	25	169,8	147,6	85	215,1	186,9			
46	34,7	30,2	06	80,0	69,5	66	125,3	108,9	26	170,6	148,2	86	215,8	187,6			
47	35,5	30,8	07	80,8	70,2	67	126,0	109,5	27	171,3	148,9	87	216,6	188,3			
48	36,2	31,5	08	81,5	70,8	68	126,8	110,2	28	172,1	149,6	88	217,4	188,9			
49	37,0	32,1	09	82,3	71,5	69	127,5	110,9	29	172,8	150,2	89	218,1	189,1			
50	37,7	32,8	10	83,0	72,2	70	128,3	111,5	30	173,6	150,9	290	218,9	190,3			
51	38,5	33,5	111	83,8	72,8	171	129,1	112,2	231	174,3	151,5	291	219,6	190,9			
52	39,2	34,1	12	84,5	73,5	72	129,8	112,8	32	175,1	152,2	92	220,4	191,5			
53	40,0	34,8	13	85,3	74,1	73	130,6	113,5	33	175,8	152,8	93	221,1	192,2			
54	40,8	35,4	14	86,0	74,8	74	131,3	114,1	34	176,6	153,5	94	221,9	192,8			
55	41,5	36,1	15	86,8	75,4	75	132,1	114,8	35	177,4	154,1	95	222,6	193,5			
56	42,3	36,7	16	87,5	76,1	76	132,8	115,4	36	178,1	154,8	96	223,4	194,2			
57	43,0	37,4	17	88,3	76,7	77	133,6	116,1	37	178,9	155,5	97	224,2	194,8			
58	43,8	38,0	18	89,1	77,4	78	134,3	116,8	38	179,6	156,1	98	224,9	195,5			
59	44,5	38,7	19	89,8	78,1	79	135,1	117,4	39	180,4	156,8	99	225,7	196,1			
60	45,3	39,4	20	90,6	78,7	80	135,8	118,1	40	181,1	157,4	300	226,4	196,8			
Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.

[h]

for 49 Deg.

Difference of Latitude and Departure for 42 Deg.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00,7	00,7	61	45,3	40,8	121	89,9	80,9	181	134,5	121,1	241	179,0	161,2
2	01,5	01,3	62	46,1	41,5	22	90,6	81,6	82	135,2	121,8	42	179,8	161,9
3	02,2	02,0	63	46,8	42,1	23	91,4	82,3	83	135,9	122,4	43	180,5	162,6
4	03,0	02,7	64	47,5	42,8	24	92,1	83,0	84	136,7	123,1	44	181,3	163,2
5	03,7	03,3	65	48,3	43,5	25	92,9	83,6	85	137,4	123,8	45	182,0	163,9
6	04,5	04,0	66	49,0	44,2	26	93,6	84,3	86	138,2	124,4	46	182,7	164,6
7	05,2	04,7	67	49,8	44,8	27	94,3	85,0	87	138,9	125,1	47	183,5	165,2
8	05,9	05,4	68	50,5	45,5	28	95,1	85,6	88	139,7	125,8	48	184,2	165,9
9	06,7	06,0	69	51,3	46,2	29	95,8	86,3	89	140,4	126,4	49	185,0	166,6
10	07,4	06,7	70	52,0	46,8	30	96,6	87,0	90	141,1	127,1	50	185,7	167,2
11	08,2	07,4	71	52,7	47,5	31	97,3	87,6	91	141,9	127,8	51	186,5	167,9
12	08,9	08,0	72	53,5	48,2	32	98,1	88,3	92	142,6	128,4	52	187,2	168,6
13	09,7	08,7	73	54,2	48,8	33	98,8	89,0	93	143,4	129,1	53	187,9	169,3
14	10,4	09,4	74	55,0	49,5	34	99,5	89,6	94	144,1	129,8	54	188,7	169,9
15	11,1	10,0	75	55,7	50,2	35	100,3	90,3	95	144,9	130,5	55	189,4	170,6
16	11,9	10,7	76	56,5	50,9	36	101,0	91,0	96	145,6	131,1	56	190,2	171,3
17	12,6	11,4	77	57,2	51,5	37	101,8	91,7	97	146,3	131,8	57	190,9	171,9
18	13,4	12,0	78	57,9	52,2	38	102,5	92,3	98	147,1	132,5	58	191,7	172,6
19	14,1	12,7	79	58,7	52,9	39	103,3	93,0	99	147,8	133,1	59	192,4	173,3
20	14,9	13,4	80	59,4	53,5	40	104,0	93,7	200	148,6	133,8	60	193,1	173,9
21	15,6	14,0	81	60,2	54,2	41	104,7	94,3	201	149,3	134,5	61	193,9	174,6
22	16,3	14,7	82	60,9	54,9	42	105,5	95,0	02	150,1	135,1	62	194,6	175,3
23	17,1	15,4	83	61,7	55,5	43	106,2	95,7	03	150,8	135,8	63	195,4	175,9
24	17,8	16,1	84	62,4	56,2	44	107,0	96,3	04	151,5	136,5	64	196,1	176,6
25	18,6	16,7	85	63,1	56,9	45	107,7	97,0	05	152,3	137,1	65	196,9	177,3
26	19,3	17,4	86	63,9	57,5	46	108,5	97,7	06	153,0	137,8	66	197,6	177,9
27	20,1	18,1	87	64,6	58,2	47	109,2	98,3	07	153,8	138,5	67	198,3	178,6
28	20,8	18,7	88	65,4	58,9	48	109,9	99,0	08	154,5	139,1	68	199,1	179,3
29	21,5	19,4	89	66,1	59,5	49	110,7	99,7	09	155,3	139,8	69	199,8	180,0
30	22,3	20,1	90	66,9	60,2	50	111,4	100,4	100	156,0	140,5	70	200,6	180,6
31	23,0	20,7	91	67,6	60,9	51	112,2	101,0	211	256,7	141,2	271	201,3	181,3
32	23,8	21,4	92	68,3	61,5	52	112,9	101,7	12	157,5	141,8	72	202,1	182,0
33	24,5	22,1	93	69,1	62,2	53	113,7	102,4	13	158,2	142,5	73	202,8	182,5
34	25,3	22,7	94	69,8	62,9	54	114,4	103,0	14	159,0	142,2	74	203,5	183,3
35	26,0	23,4	95	70,6	63,6	55	115,1	103,7	15	159,7	143,8	75	204,3	184,0
36	26,7	24,1	96	71,3	64,2	56	115,9	104,4	16	160,5	144,5	76	205,0	184,6
37	27,5	24,8	97	72,1	64,9	57	116,6	105,0	17	161,2	145,2	77	205,8	185,3
38	28,2	25,4	98	72,8	65,5	58	117,4	105,7	18	161,9	145,8	78	206,5	186,0
39	29,0	26,1	99	73,5	66,2	59	118,1	106,4	19	162,7	146,5	79	207,3	186,6
40	29,7	26,8	100	74,3	66,9	60	118,9	107,0	20	163,4	147,2	80	208,0	187,3
41	30,5	27,4	101	75,0	67,6	61	119,6	107,7	221	164,2	147,8	281	208,7	188,0
42	31,2	28,1	02	75,8	68,2	62	120,3	108,4	22	164,9	148,5	82	209,5	188,7
43	31,9	28,8	03	76,5	68,9	63	121,1	109,0	23	165,7	149,2	83	210,2	189,3
44	32,7	29,4	04	77,3	69,6	64	121,8	109,7	24	166,4	149,9	84	211,0	190,0
45	33,4	30,1	05	78,0	70,2	65	122,6	110,4	25	167,1	150,5	85	211,7	190,7
46	34,2	30,8	06	78,7	70,9	66	123,3	111,0	26	167,9	151,2	86	212,5	191,3
47	34,9	31,4	07	79,5	71,6	67	124,1	111,7	27	168,6	151,9	87	213,2	192,0
48	35,7	32,1	08	80,2	72,3	68	124,8	112,4	28	169,4	152,5	88	213,9	192,7
49	36,4	32,8	09	81,0	72,9	69	125,5	113,1	29	170,1	153,2	89	214,7	193,3
50	37,1	33,5	10	81,7	73,6	70	126,3	113,7	30	170,9	153,9	90	215,4	194,0
51	37,9	34,1	111	82,5	74,3	171	127,0	114,4	231	171,6	154,5	291	216,2	194,7
52	38,6	34,8	12	83,2	74,9	72	127,8	115,1	32	172,3	155,2	92	216,9	195,3
53	39,4	35,5	13	83,9	75,6	73	128,5	115,7	33	173,1	155,9	93	217,7	196,0
54	40,1	36,1	14	84,7	76,3	74	129,3	116,4	34	173,8	156,5	94	218,4	196,7
55	40,9	36,8	15	85,4	76,9	75	130,0	117,1	35	174,6	157,2	95	219,1	197,4
56	41,6	37,5	16	86,2	77,6	76	130,7	117,7	36	175,3	157,9	96	219,9	198,0
57	42,3	38,1	17	86,9	78,3	77	131,5	118,4	37	176,1	158,5	97	220,6	198,7
58	43,1	38,8	18	87,7	78,9	78	132,2	119,1	38	176,8	159,2	98	221,4	199,4
59	43,8	39,5	19	88,4	79,6	79	133,0	119,7	39	177,5	159,9	99	222,1	200,0
60	44,6	40,1	20	89,1	80,2	80	133,7	120,4	40	178,3	160,6	200	222,9	200,7
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

Difference of Latitude and Departure for 43 Deg.

Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.
1	00,7	00,7	61	44,6	41,6	121	88,5	82,5	181	132,4	123,4	241	176,3	164,3
2	01,5	01,4	62	45,3	42,3	22	89,2	83,2	82	133,1	124,1	42	177,0	165,0
3	02,2	02,0	63	46,1	43,0	23	90,0	83,9	83	133,8	124,8	43	177,7	165,7
4	02,9	02,7	64	46,8	43,6	24	90,7	84,5	84	134,6	125,5	44	178,4	166,4
5	03,7	03,4	65	47,5	44,3	25	91,4	85,2	85	135,3	126,2	45	179,2	167,1
6	04,4	04,1	66	48,3	45,0	26	92,1	85,9	86	136,0	126,8	46	179,9	167,7
7	05,1	04,8	67	49,0	45,7	27	92,9	86,6	87	136,8	127,5	47	180,6	168,4
8	05,9	05,5	68	49,7	46,4	28	93,6	87,3	88	137,5	128,2	48	181,4	169,1
9	06,6	06,2	69	50,5	47,1	29	94,3	88,0	89	138,2	128,9	49	182,1	169,8
10	07,3	06,8	70	51,2	47,7	30	95,1	88,6	90	139,0	129,5	50	182,8	170,5
11	08,0	07,5	71	51,9	48,4	131	95,8	89,3	191	139,7	130,2	251	183,6	171,2
12	08,8	08,2	72	52,7	49,1	32	96,5	90,0	92	140,4	130,9	52	184,3	171,8
13	09,5	08,9	73	53,4	49,8	33	97,3	90,7	93	141,1	131,6	53	185,0	172,5
14	10,2	09,5	74	54,1	50,5	34	98,0	91,4	94	141,9	132,4	54	185,8	173,2
15	11,0	10,2	75	54,9	51,2	35	98,7	92,1	95	142,6	133,0	55	186,5	173,9
16	11,7	10,9	76	55,6	51,8	36	99,5	92,7	96	143,3	133,6	56	187,2	174,5
17	12,4	11,6	77	56,3	52,5	37	100,2	93,4	97	144,1	134,3	57	187,9	175,2
18	13,2	12,3	78	57,0	53,2	38	100,9	94,1	98	144,8	135,0	58	188,7	175,9
19	13,9	13,0	79	57,8	53,9	39	101,7	94,8	99	145,5	135,7	59	189,4	176,6
20	14,6	13,6	80	58,5	54,5	40	102,4	95,5	200	146,3	136,4	60	190,1	177,3
21	15,4	14,3	81	59,2	55,2	141	103,1	96,2	201	147,0	137,1	261	190,9	178,0
22	16,1	15,0	82	60,0	55,9	42	103,9	96,8	02	147,7	137,7	62	191,6	178,6
23	16,8	15,7	83	60,7	56,6	43	104,6	97,5	03	148,5	138,4	63	192,3	179,3
24	17,6	16,4	84	61,4	57,3	44	105,3	98,2	04	149,2	139,1	64	193,1	180,0
25	18,3	17,1	85	62,2	58,0	45	106,0	98,9	05	149,9	139,8	65	193,8	180,7
26	19,0	17,7	86	62,9	58,6	46	106,8	99,5	06	150,7	140,5	66	194,5	181,4
27	19,7	18,4	87	63,6	59,3	47	107,5	100,2	07	151,4	141,2	67	195,3	182,1
28	20,5	19,1	88	64,4	60,0	48	108,2	100,9	08	152,1	141,8	68	196,0	182,7
29	21,2	19,8	89	65,1	60,7	49	109,0	101,6	09	152,9	142,5	69	196,7	183,4
30	21,9	20,5	90	65,8	61,4	50	109,7	102,3	10	153,6	143,2	70	197,5	184,1
31	22,7	21,2	91	66,6	62,1	151	110,4	103,0	211	154,3	143,9	271	198,2	184,8
32	23,4	21,8	92	67,3	62,7	52	111,2	103,6	12	155,0	144,5	72	198,9	185,5
33	24,1	22,5	93	68,0	63,4	53	111,9	104,3	13	155,8	145,2	73	199,7	186,2
34	24,9	23,2	94	68,7	64,1	54	112,6	105,0	14	156,5	145,9	74	200,4	186,8
35	25,6	23,9	95	69,5	64,8	55	113,4	105,7	15	157,2	146,6	75	201,1	187,5
36	26,3	24,5	96	70,2	65,5	56	114,1	106,4	16	158,0	147,3	76	201,9	188,2
37	27,1	25,2	97	70,9	66,2	57	114,8	107,1	17	158,7	148,0	77	202,6	188,9
38	27,8	25,9	98	71,7	66,8	58	115,6	107,7	18	159,4	148,6	78	203,3	189,5
39	28,5	26,6	99	72,4	67,5	59	116,3	108,4	19	160,2	149,3	79	204,0	190,2
40	29,3	27,3	100	73,1	68,2	60	117,0	109,1	20	160,9	150,0	80	204,8	190,9
41	30,0	28,0	101	73,9	68,9	161	117,7	109,8	221	161,6	150,7	281	205,5	191,6
42	30,7	28,6	02	74,6	69,5	62	118,5	110,5	22	162,4	151,4	82	206,2	192,3
43	31,4	29,3	03	75,3	70,2	63	119,2	111,2	23	163,1	152,1	83	207,0	193,0
44	32,2	30,0	04	76,1	70,9	64	119,9	111,8	24	163,8	152,7	84	207,7	193,6
45	32,9	30,7	05	76,8	71,6	65	120,7	112,5	25	164,6	153,4	85	208,4	194,3
46	33,6	31,4	06	77,5	72,3	66	121,4	113,2	26	165,3	154,1	86	209,2	195,0
47	34,4	32,1	07	78,3	73,0	67	122,1	113,9	27	166,0	154,8	87	209,9	195,7
48	35,1	32,7	08	79,0	73,6	68	122,9	114,5	28	166,7	155,5	88	210,6	196,4
49	35,8	33,4	09	79,7	74,3	69	123,6	115,2	29	167,5	156,2	89	211,4	197,1
50	36,6	34,1	10	80,4	75,0	70	124,3	115,9	30	168,2	156,8	90	212,1	197,7
51	37,3	34,8	111	81,2	75,7	171	125,1	116,6	231	168,9	157,5	291	212,8	198,4
52	38,0	35,5	12	81,9	76,4	72	125,8	117,3	32	169,7	158,2	92	213,6	199,1
53	38,8	36,2	13	82,6	77,1	73	126,5	118,0	33	170,4	158,9	93	214,3	199,8
54	39,5	36,8	14	83,4	77,7	74	127,3	118,6	34	171,1	159,5	94	215,0	200,5
55	40,2	37,5	15	84,1	78,4	75	128,0	119,3	35	171,9	160,2	95	215,7	201,2
56	41,0	38,2	16	84,8	79,1	76	128,7	120,0	36	172,6	160,9	96	216,5	201,8
57	41,7	38,9	17	85,6	79,8	77	129,4	120,7	37	173,3	161,6	97	217,2	202,5
58	42,4	39,5	18	86,3	80,5	78	130,2	121,4	38	174,1	162,3	98	218,0	203,2
59	43,1	40,2	19	87,0	81,2	79	130,9	122,1	39	174,8	163,0	99	218,7	203,9
60	43,9	40,9	20	87,8	81,8	80	131,6	122,7	40	175,5	163,6	300	219,4	204,6
Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.

Difference of Latitude and Departure for 44 Deg.

D. ft.	Lat.	Dep.	D. ft.	Lat.	Dep.	D. ft.	Lat.	Dep.	D. ft.	Lat.	Dep.	D. ft.	Lat.	Dep.
1	00,7	00,7	61	43,9	42,4	121	87,0	84,0	181	130,2	125,7	241	177,4	107,4
2	01,4	01,4	62	44,6	43,1	22	87,8	84,7	82	130,9	126,4	42	174,1	168,1
3	02,2	02,1	63	45,3	43,8	23	88,5	85,4	83	131,6	127,1	43	174,8	168,8
4	02,9	02,8	64	46,0	44,5	24	89,2	86,1	84	132,4	127,8	44	175,5	169,5
5	03,6	03,5	65	46,8	45,1	25	89,9	86,8	85	133,1	128,5	45	176,2	170,2
6	04,3	04,2	66	47,5	45,8	26	90,6	87,5	86	133,8	129,2	46	176,9	170,9
7	05,0	04,9	67	48,2	46,5	27	91,4	88,2	87	134,5	129,9	47	177,7	171,6
8	05,8	05,9	68	48,9	47,2	28	92,1	88,9	88	135,2	130,6	48	178,4	172,3
9	06,5	06,3	69	49,6	47,9	29	92,8	89,6	89	135,9	131,3	49	179,1	173,0
10	07,2	06,9	70	50,4	48,6	30	93,5	90,2	90	136,7	132,0	50	179,8	173,6
11	07,9	07,6	71	51,1	49,3	31	94,2	91,0	91	137,4	132,7	51	180,5	174,3
12	08,6	08,3	72	51,8	50,0	32	94,9	91,7	92	138,1	133,4	52	181,3	175,0
13	09,4	09,0	73	52,5	50,7	33	95,7	92,4	93	138,8	134,1	53	182,0	175,7
14	10,1	09,7	74	53,2	51,4	34	96,4	93,1	94	139,5	134,8	54	182,7	176,4
15	10,8	10,4	75	53,9	52,1	35	97,1	93,8	95	140,3	135,5	55	183,4	177,1
16	11,5	11,1	76	54,7	52,8	36	97,8	94,5	96	141,0	136,1	56	184,1	177,8
17	12,2	11,8	77	55,4	53,5	37	98,5	95,2	97	141,7	136,8	57	184,9	178,5
18	12,9	12,5	78	56,1	54,2	38	99,3	95,9	98	142,4	137,5	58	185,6	179,2
19	13,7	13,2	79	56,8	54,9	39	100,0	96,6	99	143,1	138,2	59	186,3	179,9
20	14,4	13,9	80	57,5	55,6	40	100,7	97,2	200	143,9	138,9	60	187,0	180,0
21	15,1	14,6	81	58,3	56,3	41	101,4	97,9	201	144,6	139,6	61	187,7	181,3
22	15,8	15,3	82	59,0	57,0	42	102,1	98,6	02	145,3	140,3	62	188,5	182,0
23	16,5	16,0	83	59,7	57,7	43	102,9	99,3	03	146,0	141,0	63	189,2	182,7
24	17,3	16,7	84	60,4	58,3	44	103,6	100,0	04	146,7	141,7	64	189,9	183,4
25	18,0	17,4	85	61,1	59,0	45	104,3	100,7	05	147,5	142,4	65	190,6	184,1
26	18,7	18,1	86	61,9	59,7	46	105,0	101,4	06	148,2	143,1	66	191,3	184,8
27	19,4	18,8	87	62,6	60,4	47	105,7	102,1	07	148,9	143,8	67	192,1	185,5
28	20,1	19,4	88	63,3	61,1	48	106,5	102,8	08	149,6	144,5	68	192,8	186,1
29	21,9	20,1	89	64,0	61,8	49	107,2	103,5	09	150,3	145,2	69	193,5	186,8
30	21,6	20,8	90	64,7	62,5	50	107,9	104,2	10	151,1	145,9	70	194,2	187,5
31	22,3	21,5	91	65,5	63,2	51	108,6	104,9	211	151,8	146,6	71	194,9	188,2
32	23,0	22,2	92	66,2	63,9	52	109,3	105,6	12	152,5	147,3	72	195,6	188,9
33	23,7	22,9	93	66,9	64,6	53	110,1	106,3	13	153,2	147,9	73	196,4	189,6
34	24,5	23,6	94	67,6	65,3	54	110,8	107,0	14	153,9	148,6	74	197,1	190,3
35	25,2	24,3	95	68,3	66,0	55	111,5	107,7	15	154,6	149,3	75	197,8	191,0
36	25,9	25,0	96	69,1	66,7	56	112,2	108,4	16	155,4	150,0	76	198,5	191,7
37	26,6	25,7	97	69,8	67,4	57	112,9	109,1	17	156,1	150,7	77	199,2	192,4
38	27,3	26,4	98	70,5	68,1	58	113,6	109,7	18	156,8	151,4	78	200,0	193,1
39	28,1	27,1	99	71,2	68,8	59	114,4	110,4	19	157,5	152,1	79	200,7	193,8
40	28,8	27,8	100	71,9	69,5	60	115,1	111,1	20	158,2	152,8	80	201,4	194,5
41	29,5	28,5	101	72,6	70,2	61	115,8	111,8	221	159,0	153,5	281	202,1	195,2
42	30,2	29,2	02	73,4	70,8	62	116,5	112,5	22	159,7	154,2	82	202,8	195,9
43	30,9	29,9	03	74,1	71,5	63	117,2	113,2	23	160,4	154,9	83	203,6	196,6
44	31,6	30,6	04	74,8	72,2	64	118,0	113,9	24	161,1	155,6	84	204,3	197,3
45	32,4	31,3	05	75,5	72,9	65	118,7	114,6	25	161,8	156,3	85	205,0	198,0
46	33,1	32,0	06	76,2	73,6	66	119,4	115,3	26	162,6	157,0	86	205,7	198,7
47	33,8	32,6	07	77,0	74,3	67	120,1	116,0	27	163,3	157,7	87	206,4	199,3
48	34,5	33,3	08	77,7	75,0	68	120,8	116,7	28	164,0	158,4	88	207,2	200,0
49	35,2	34,0	09	78,4	75,7	69	121,6	117,4	29	164,7	159,1	89	207,9	200,7
50	36,0	34,7	10	79,1	76,4	70	122,3	118,1	30	165,4	159,8	90	208,6	201,4
51	36,7	35,4	11	79,8	77,1	71	123,0	118,8	231	166,2	160,4	291	209,3	202,1
52	37,4	36,1	12	80,6	77,8	72	123,7	119,5	32	166,9	161,1	92	210,0	202,8
53	38,1	36,8	13	81,3	78,5	73	124,4	120,2	33	167,6	161,8	93	210,8	203,5
54	38,8	37,5	14	82,0	79,2	74	125,2	120,9	34	168,3	162,5	94	211,5	204,2
55	39,6	38,2	15	82,7	79,9	75	125,9	121,6	35	169,0	163,2	95	212,2	204,9
56	40,3	38,9	16	83,4	80,6	76	126,6	122,2	36	169,8	163,9	96	212,9	205,6
57	41,0	39,6	17	84,2	81,3	77	127,3	122,9	37	170,5	164,6	97	213,6	206,3
58	41,7	40,3	18	84,9	82,0	78	128,0	123,6	38	171,2	165,3	98	214,4	207,0
59	42,4	41,0	19	85,6	82,7	79	128,8	124,3	39	171,9	166,0	99	215,1	207,7
60	43,2	41,7	20	86,3	83,4	80	129,5	125,0	40	172,6	166,7	300	215,8	208,4

for 46 Deg.

Difference of Latitude and Departure for 45 Deg.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00,7	00,7	61	43,1	43,1	121	85,6	85,6	181	128,0	128,0	241	170,4	170,4
2	01,2	01,4	62	43,8	43,8	22	86,3	86,3	82	128,7	128,7	42	171,1	171,1
3	02,1	02,1	63	44,5	44,5	23	87,0	87,0	83	129,4	129,4	43	171,8	171,8
4	02,8	02,8	64	45,3	45,3	24	87,7	87,7	84	130,1	130,1	44	172,5	172,5
5	03,5	03,5	65	46,0	46,0	25	88,4	88,4	85	130,8	130,8	45	173,2	173,2
6	04,2	04,2	66	46,7	46,7	26	89,1	89,1	86	131,5	131,5	46	173,9	173,9
7	04,9	04,9	67	47,4	47,4	27	89,8	89,8	87	132,2	132,2	47	174,6	174,6
8	05,7	05,7	68	48,1	48,1	28	90,5	90,5	88	132,9	132,9	48	175,4	175,4
9	06,4	06,4	69	48,8	48,8	29	91,2	91,2	89	133,6	133,6	49	176,1	176,1
10	07,1	07,1	70	49,5	49,5	30	91,9	91,9	90	134,3	134,3	50	176,8	176,8
11	07,8	07,8	71	50,2	50,2	31	92,6	92,6	91	135,1	135,1	51	177,5	177,5
12	08,5	08,5	72	50,9	50,9	32	93,3	93,3	92	135,8	135,8	52	178,2	178,2
13	09,2	09,2	73	51,6	51,6	33	94,0	94,0	93	136,5	136,5	53	178,9	178,9
14	09,9	09,9	74	52,3	52,3	34	94,7	94,7	94	137,2	137,2	54	179,6	179,6
15	10,6	10,6	75	53,0	53,0	35	95,5	95,5	95	137,9	137,9	55	180,3	180,3
16	11,3	11,3	76	53,7	53,7	36	96,2	96,2	96	138,6	138,6	56	181,0	181,0
17	12,0	12,0	77	54,4	54,4	37	96,9	96,9	97	139,3	139,3	57	181,7	181,7
18	12,7	12,7	78	55,2	55,2	38	97,6	97,6	98	140,0	140,0	58	182,4	182,4
19	13,4	13,4	79	55,9	55,9	39	98,3	98,3	99	140,7	140,7	59	183,1	183,1
20	14,1	14,1	80	56,6	56,6	40	99,0	99,0	200	141,4	141,4	60	183,8	183,8
21	14,8	14,8	81	57,3	57,3	41	99,7	99,7	201	142,1	142,1	61	184,5	184,5
22	15,6	15,6	82	58,0	58,0	42	100,4	100,4	02	142,8	142,8	62	185,3	185,3
23	16,3	16,3	83	58,7	58,7	43	101,1	101,1	03	143,5	143,5	63	186,0	186,0
24	17,0	17,0	84	59,4	59,4	44	101,8	101,8	04	144,2	144,2	64	186,7	186,7
25	17,7	17,7	85	60,1	60,1	45	102,5	102,5	05	144,9	144,9	65	187,4	187,4
26	18,4	18,4	86	60,8	60,8	46	103,2	103,2	06	145,7	145,7	66	188,1	188,1
27	19,1	19,1	87	61,5	61,5	47	103,9	103,9	07	146,4	146,4	67	188,8	188,8
28	19,8	19,8	88	62,2	62,2	48	104,6	104,6	08	147,1	147,1	68	189,5	189,5
29	20,5	20,5	89	62,9	62,9	49	105,4	105,4	09	147,8	147,8	69	190,2	190,2
30	21,2	21,2	90	63,6	63,6	50	106,1	106,1	10	148,5	148,5	70	190,9	190,9
31	21,9	21,9	91	64,3	64,3	51	106,8	106,8	21	149,2	149,2	71	191,6	191,6
32	22,6	22,6	92	65,1	65,1	52	107,5	107,5	12	149,9	149,9	72	192,3	192,3
33	23,3	23,3	93	65,8	65,8	53	108,2	108,2	13	150,6	150,6	73	193,0	193,0
34	24,0	24,0	94	66,5	66,5	54	108,9	108,9	14	151,3	151,3	74	193,7	193,7
35	24,7	24,7	95	67,2	67,2	55	109,6	109,6	15	152,0	152,0	75	194,4	194,4
36	25,5	25,5	96	67,9	67,9	56	110,3	110,3	16	152,7	152,7	76	195,2	195,2
37	26,2	26,2	97	68,6	68,6	57	111,0	111,0	17	153,4	153,4	77	195,9	195,9
38	26,9	26,9	98	69,3	69,3	58	111,7	111,7	18	154,1	154,1	78	196,6	196,6
39	27,6	27,6	99	70,0	70,0	59	112,4	112,4	19	154,8	154,8	79	197,3	197,3
40	28,3	28,3	100	70,7	70,7	60	113,1	113,1	20	155,6	155,6	80	198,0	198,0
41	29,0	29,0	101	71,4	71,4	61	113,8	113,8	21	156,3	156,3	81	198,7	198,7
42	29,7	29,7	02	72,1	72,1	62	114,5	114,5	22	157,0	157,0	82	199,4	199,4
43	30,4	30,4	03	72,8	72,8	63	115,3	115,3	23	157,7	157,7	83	200,1	200,1
44	31,1	31,1	04	73,5	73,5	64	116,0	116,0	24	158,4	158,4	84	200,8	200,8
45	31,8	31,8	05	74,2	74,2	65	116,7	116,7	25	159,1	159,1	85	201,5	201,5
46	32,5	32,5	06	74,9	74,9	66	117,4	117,4	26	159,8	159,8	86	202,2	202,2
47	33,2	33,2	07	75,7	75,7	67	118,1	118,1	27	160,5	160,5	87	202,9	202,9
48	33,9	33,9	08	76,4	76,4	68	118,8	118,8	28	161,2	161,2	88	203,6	203,6
49	34,6	34,6	09	77,1	77,1	69	119,5	119,5	29	161,9	161,9	89	204,3	204,3
50	35,4	35,4	10	77,8	77,8	70	120,2	120,2	30	162,6	162,6	90	205,1	205,1
51	36,1	36,1	11	78,5	78,5	71	120,9	120,9	21	163,3	163,3	291	205,8	205,8
52	36,8	36,8	12	79,2	79,2	72	121,6	121,6	32	164,0	164,0	92	206,5	206,5
53	37,5	37,5	13	79,9	79,9	73	122,3	122,3	33	164,7	164,7	93	207,2	207,2
54	38,2	38,2	14	80,6	80,6	74	123,0	123,0	34	165,5	165,5	94	207,9	207,9
55	38,9	38,9	15	81,3	81,3	75	123,7	123,7	35	166,2	166,2	95	208,6	208,6
56	39,6	39,6	16	82,0	82,0	76	124,4	124,4	36	166,9	166,9	96	209,3	209,3
57	40,3	40,3	17	82,7	82,7	77	125,2	125,2	37	167,6	167,6	97	210,0	210,0
58	41,0	41,0	18	83,4	83,4	78	125,9	125,9	38	168,3	168,3	98	210,7	210,7
59	41,7	41,7	19	84,1	84,1	79	126,6	126,6	39	169,0	169,0	99	211,4	211,4
60	42,4	42,4	20	84,8	84,8	80	127,3	127,3	40	169,7	169,7	300	212,1	212,1
Dist	Dep.	Lat.	Dist	Lat.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Of Logarithmic Sines, Tangents, and Secants, to every Point and Quarter Point of the Compass.

Points.	Sines.	Co-sines.	Tangents.	Co-tang.	Secants.	Co-secan.	Points.
0	0.00000	10.00000	0.00000	Infinite.	10.00000	Infinite.	8
0 $\frac{1}{4}$ E. N. E.	8.69079	9.99947	8.69131	11.30867	10.00053	11.30921	7 $\frac{3}{4}$
0 $\frac{1}{2}$ E.	8.99130	9.99790	8.99340	11.00660	10.00210	11.00870	7 $\frac{1}{2}$
0 $\frac{3}{4}$ E.	9.16652	9.99527	9.17124	10.82875	10.00473	10.83348	7 $\frac{1}{4}$
1	9.29024	9.99157	9.29866	10.70134	10.00843	10.70976	7
1 $\frac{1}{4}$ E. N. E.	9.38557	9.98679	9.39878	10.60121	10.01321	10.61443	6 $\frac{3}{4}$
1 $\frac{1}{2}$ E.	9.46282	9.98088	9.48194	10.51806	10.01912	10.53717	6 $\frac{1}{2}$
1 $\frac{3}{4}$ E.	9.52749	9.97388	9.55365	10.44639	10.02616	10.47251	6 $\frac{1}{4}$
2	9.58284	9.96562	9.61722	10.38278	10.03438	10.41716	6
2 $\frac{1}{4}$ E. N. E.	9.63099	9.95616	9.67482	10.32518	10.04384	10.36901	5 $\frac{3}{4}$
2 $\frac{1}{2}$ E.	9.67339	9.94543	9.72796	10.27204	10.05457	10.32661	5 $\frac{1}{2}$
2 $\frac{3}{4}$ E.	9.71104	9.93335	9.77770	10.22230	10.06665	10.28895	5 $\frac{1}{4}$
3	9.74474	9.91985	9.82489	10.17511	10.08015	10.25526	5
3 $\frac{1}{4}$ E. N. E.	9.77503	9.90483	9.87020	10.12980	10.09517	10.22497	4 $\frac{3}{4}$
3 $\frac{1}{2}$ E.	9.80236	9.88819	9.91417	10.08583	10.11181	10.19764	4 $\frac{1}{2}$
3 $\frac{3}{4}$ E.	9.82708	9.86979	9.95729	10.04270	10.13021	10.17292	4 $\frac{1}{4}$
4	9.84948	9.84948	10.00000	10.00000	10.15052	10.15052	4
	Co-sines.	Sines.	Co-tang.	Tangents	Co-secan.	Secants.	

A TABLE of Logarithms from 1 to 10.000.

No.	Log.	No.	Log.	No.	Log.	No.	Log.	No.	Log.
1	0.00000	21	1.32222	41	1.61278	61	1.78533	81	1.90848
2	0.30103	22	34242	42	62325	62	79239	82	91381
3	0.47712	23	36173	43	63347	63	79934	83	91908
4	0.60206	24	38021	44	64345	64	80618	84	92428
5	0.69897	25	39794	45	65321	65	81291	85	92942
6	0.77815	26	41497	46	66276	66	81954	86	93450
7	0.84510	27	43136	47	67210	67	82607	87	93952
8	0.90309	28	44716	48	68124	68	83251	88	94448
9	0.95424	29	46240	49	69020	69	83885	89	94939
10	1.00000	30	47712	50	69897	70	84510	90	95424
11	1.04139	31	1.49136	51	1.70757	71	1.85126	91	1.95904
12	07918	32	50515	52	71600	72	85733	92	96379
13	11394	33	51851	53	72428	73	86332	93	96848
14	14613	34	53148	54	73239	74	86923	94	97313
15	17609	35	54407	55	74036	75	87506	95	97772
16	20412	36	55630	56	74819	76	88081	96	98227
17	23045	37	56820	57	75587	77	88649	97	98677
18	25527	38	57978	58	76343	78	89209	98	99123
19	27875	39	59106	59	77085	79	89763	99	99563
20	30103	40	60206	60	77815	80	90309	100	2.00000

A Table of Logarithms from 1 to 10,000.

0	1	2	3	4	5	6	7	8	9
2.00000	2.00043	2.00087	2.00130	2.00173	2.00217	2.00261	2.00303	2.00346	2.00389
00432	00475	00518	00561	00604	00647	00689	00732	00775	00817
00860	00903	00945	00988	01030	01072	01115	01157	01199	01242
01284	01326	01368	01410	01452	01494	01536	01578	01620	01661
01703	01745	01787	01828	01870	01912	01953	01995	02036	02077
02119	02160	02202	02243	02284	02325	02366	02407	02449	02490
02531	02572	02612	02653	02694	02735	02776	02816	02857	02898
02938	02979	03019	03060	03100	03141	03181	03222	03262	03302
03342	03383	03423	03463	03503	03543	03583	03623	03663	03703
03743	03782	03822	03862	03902	03941	03981	04021	04060	04100
2.04139	2.04179	2.04218	2.04257	2.04297	2.04336	2.04375	2.04415	2.04454	2.04493
04532	04571	04610	04649	04688	04727	04766	04805	04844	04883
04922	04961	04999	05038	05077	05115	05154	05192	05231	05269
05308	05346	05385	05423	05461	05500	05538	05576	05614	05652
05690	05729	05767	05805	05843	05881	05918	05956	05994	06032
06070	06108	06145	06183	06221	06258	06296	06333	06371	06408
06446	06483	06521	06558	06595	06633	06670	06707	06744	06781
06819	06856	06893	06930	06967	07004	07041	07078	07114	07151
07188	07225	07262	07298	07335	07372	07408	07445	07482	07518
07555	07591	07628	07664	07700	07737	07773	07809	07846	07882
2.07918	2.07954	2.07990	2.08027	2.08063	2.08099	2.08135	2.08171	2.08207	2.08243
08278	08314	08350	08386	08422	08458	08493	08529	08565	08600
08636	08672	08707	08743	08778	08814	08849	08884	08920	08955
08990	09026	09061	09096	09131	09167	09202	09237	09272	09307
09342	09377	09412	09447	09482	09517	09552	09587	09621	09656
09691	09726	09760	09795	09830	09864	09899	09934	09968	10003
10037	10071	10106	10140	10175	10209	10243	10278	10312	10347
10380	10414	10449	10483	10517	10551	10585	10619	10653	10687
10721	10755	10789	10823	10856	10890	10924	10958	10992	11025
11059	11093	11126	11160	11193	11227	11260	11294	11327	11361
2.11394	2.11428	2.11461	2.11494	2.11528	2.11561	2.11594	2.11628	2.11661	2.11694
11727	11760	11793	11826	11860	11893	11926	11959	11991	12024
12057	12090	12123	12156	12189	12222	12254	12287	12320	12352
12385	12418	12450	12483	12516	12548	12581	12613	12646	12678
12710	12743	12775	12808	12840	12872	12904	12937	12969	13001
13033	13065	13098	13130	13162	13194	13226	13258	13290	13322
13354	13386	13418	13450	13481	13513	13545	13577	13609	13640
13672	13704	13735	13767	13799	13830	13862	13893	13925	13956
13988	14019	14051	14082	14114	14145	14176	14208	14239	14270
14301	14333	14364	14395	14426	14457	14488	14520	14551	14582
2.14613	2.14644	2.14675	2.14706	2.14737	2.14768	2.14798	2.14829	2.14860	2.14891
14922	14953	14989	15014	15045	15076	15106	15137	15168	15198
15229	15259	15290	15320	15351	15381	15412	15442	15473	15503
15534	15564	15594	15625	15655	15685	15715	15746	15776	15806
15836	15866	15896	15927	15957	15987	16017	16047	16077	16107
16137	16167	16197	16227	16256	16286	16316	16346	16376	16406
16435	16465	16495	16524	16554	16584	16613	16643	16673	16702
16732	16761	16791	16820	16850	16879	16909	16938	16967	16997
17026	17055	17085	17114	17143	17173	17202	17231	17260	17289
17319	17348	17377	17406	17435	17464	17493	17522	17551	17580
2.17600	2.17638	2.17667	2.17696	2.17725	2.17754	2.17782	2.17811	2.17840	2.17869
17898	17926	17955	17984	18013	18041	18070	18099	18127	18156
18184	18213	18241	18270	18298	18327	18355	18384	18412	18441
18469	18497	18526	18554	18583	18611	18639	18667	18696	18724
18752	18780	18808	18837	18865	18893	18921	18949	18977	19005
19033	19061	19089	19117	19145	19173	19201	19229	19257	19285
19312	19340	19368	19396	19424	19451	19479	19507	19535	19562
19590	19618	19645	19673	19700	19728	19756	19783	19811	19838
19866	19893	19921	19948	19975	20003	20030	20058	20085	20112
20140	20167	20194	20222	20249	20276	20303	20330	20358	20385

A Table of Logarithms from 1 to 10,000.

No.	0	1	2	3	4	5	6	7	8	9
160	2.20412	2.20439	2.20466	2.20493	2.20520	2.20547	2.20575	2.20602	2.20629	2.20656
161	20683	20710	20736	20763	20790	20817	20844	20871	20898	20925
162	20951	20978	21005	21032	21059	21085	21112	21139	21165	21192
163	21219	21245	21272	21299	21325	21352	21378	21405	21431	21458
164	21484	21511	21537	21564	21590	21617	21643	21669	21696	21722
165	21748	21775	21801	21827	21853	21880	21906	21932	21958	21985
166	22011	22037	22063	22089	22115	22141	22167	22194	22220	22246
167	22272	22298	22324	22350	22375	22401	22427	22453	22479	22505
168	22531	22557	22583	22608	22634	22660	22686	22712	22737	22763
169	22789	22814	22840	22866	22891	22917	22943	22968	22994	23020
170	2.23045	2.23070	2.23096	2.23121	2.23147	2.23172	2.23198	2.23223	2.23249	2.23274
171	23300	23325	23350	23376	23401	23426	23452	23477	23502	23528
172	23553	23578	23603	23628	23654	23679	23704	23729	23754	23780
173	23805	23830	23855	23880	23905	23930	23955	23980	24005	24030
174	24055	24080	24105	24130	24155	24179	24204	24229	24254	24279
175	24304	24329	24353	24378	24403	24428	24452	24477	24502	24527
176	24551	24576	24601	24625	24650	24674	24699	24724	24748	24773
177	24797	24822	24846	24871	24895	24920	24944	24969	24993	25018
178	25042	25066	25091	25115	25139	25164	25188	25212	25237	25261
179	25285	25310	25334	25358	25382	25406	25431	25455	25479	25503
180	2.25527	2.25551	2.25575	2.25600	2.25624	2.25648	2.25672	2.25696	2.25720	2.25744
181	25768	25792	25816	25840	25864	25888	25912	25936	25959	25983
182	26007	26031	26055	26079	26102	26126	26150	26174	26198	26222
183	26245	26269	26292	26316	26340	26364	26387	26411	26434	26458
184	26482	26505	26529	26552	26576	26600	26623	26647	26670	26694
185	26717	26741	26764	26787	26811	26834	26858	26881	26905	26928
186	26951	26975	26998	27021	27045	27068	27091	27114	27138	27161
187	27184	27207	27231	27254	27277	27300	27323	27346	27370	27393
188	27416	27439	27462	27485	27508	27531	27554	27577	27600	27623
189	27646	27669	27692	27715	27738	27761	27784	27807	27830	27853
190	2.27875	2.27898	2.27921	2.27944	2.27967	2.27989	2.28012	2.28035	2.28058	2.28081
191	28103	28126	28149	28171	28194	28217	28239	28262	28285	28308
192	28330	28353	28375	28398	28420	28443	28466	28488	28511	28534
193	28556	28578	28601	28623	28646	28668	28690	28713	28735	28758
194	28780	28803	28825	28847	28870	28892	28914	28937	28959	28981
195	29003	29026	29048	29070	29092	29115	29137	29159	29181	29203
196	29226	29248	29270	29292	29314	29336	29358	29380	29402	29424
197	29447	29469	29491	29513	29535	29557	29579	29601	29623	29645
198	29667	29688	29710	29732	29754	29776	29798	29820	29842	29864
199	29886	29907	29929	29951	29972	29994	30016	30038	30060	30082
200	2.30103	2.30125	2.30146	2.30168	2.30190	2.30211	2.30233	2.30255	2.30276	2.30298
201	30320	30341	30363	30384	30406	30427	30449	30471	30492	30514
202	30535	30557	30578	30600	30621	30642	30663	30685	30707	30728
203	30750	30771	30792	30814	30835	30856	30878	30899	30920	30941
204	30963	30984	31006	31027	31048	31069	31091	31112	31133	31154
205	31175	31197	31218	31239	31260	31281	31302	31323	31344	31365
206	31387	31408	31429	31450	31471	31492	31513	31534	31555	31576
207	31597	31618	31639	31660	31681	31702	31723	31744	31765	31786
208	31806	31827	31848	31869	31890	31911	31931	31952	31973	31994
209	32015	32035	32056	32077	32098	32118	32139	32160	32180	32201
210	2.32222	2.32243	2.32263	2.32284	2.32305	2.32325	2.32346	2.32366	2.32387	2.32407
211	32428	32449	32469	32490	32510	32531	32552	32570	32593	32615
212	32634	32654	32674	32695	32715	32736	32756	32777	32797	32818
213	32838	32858	32879	32899	32919	32940	32960	32980	33001	33021
214	33041	33062	33082	33102	33122	33143	33163	33185	33205	33225
215	33244	33264	33284	33304	33325	33345	33365	33385	33405	33425
216	33445	33465	33486	33506	33526	33546	33566	33586	33606	33626
217	33646	33666	33686	33706	33726	33746	33766	33786	33806	33826
218	33846	33866	33885	33904	33925	33945	33965	33985	34005	34025
219	34044	34064	34084	34104	34124	34143	34163	34183	34202	34222

A Table of Logarithms from 1 to 10,000.

	0	1	2	3	4	5	6	7	8	9
2.	34242	34262	34282	34301	34321	34341	34360	34380	34400	34420
1	34439	34459	34478	34498	34518	34537	34557	34577	34596	34616
2	34635	34655	34674	34694	34713	34733	34752	34772	34791	34811
3	34830	34850	34869	34889	34908	34928	34947	34967	34986	35005
4	35025	35044	35064	35083	35102	35122	35141	35160	35180	35199
5	35218	35237	35257	35276	35295	35315	35334	35353	35372	35392
6	35411	35430	35449	35468	35488	35507	35526	35545	35564	35583
7	35603	35622	35641	35660	35679	35698	35717	35736	35755	35774
8	35793	35812	35832	35851	35870	35889	35908	35927	35946	35965
9	35983	36002	36021	36040	36059	36078	36097	36116	36135	36154
0	2.	36173	2.	36192	2.	36210	2.	36229	2.	36248
1	36261	36280	36299	36318	36336	36355	36374	36393	36411	36430
2	36449	36467	36486	36505	36524	36542	36561	36580	36598	36617
3	36636	36654	36673	36691	36710	36729	36747	36766	36784	36803
4	36822	36840	36859	36877	36896	36914	36933	36951	36970	36988
5	37007	37025	37044	37062	37081	37099	37117	37136	37154	37173
6	37191	37210	37228	37246	37265	37283	37301	37320	37338	37356
7	37375	37393	37411	37430	37448	37466	37485	37503	37521	37539
8	37558	37576	37594	37612	37631	37649	37667	37685	37703	37722
9	37740	37758	37776	37794	37812	37830	37849	37867	37885	37903
0	2.	38021	2.	38039	2.	38057	2.	38075	2.	38093
1	38102	38120	38138	38156	38174	38192	38210	38228	38246	38264
2	38281	38299	38317	38335	38353	38371	38389	38407	38425	38443
3	38461	38478	38496	38514	38532	38550	38568	38586	38603	38621
4	38639	38657	38675	38692	38710	38728	38746	38763	38781	38799
5	38817	38834	38852	38870	38887	38905	38923	38940	38958	38976
6	38993	39011	39029	39046	39064	39082	39099	39117	39134	39152
7	39170	39187	39205	39222	39240	39257	39275	39292	39310	39327
8	39345	39363	39380	39398	39415	39433	39450	39468	39485	39502
9	39520	39537	39555	39572	39590	39607	39624	39642	39659	39677
0	2.	39794	2.	39811	2.	39829	2.	39846	2.	39863
1	39876	39895	39913	39931	39949	39967	39985	39999	40017	40035
2	40053	40071	40089	40107	40125	40143	40161	40179	40197	40215
3	40233	40251	40269	40287	40305	40323	40341	40359	40377	40395
4	40413	40431	40449	40467	40485	40503	40521	40539	40557	40575
5	40593	40611	40629	40647	40665	40683	40701	40719	40737	40755
6	40773	40791	40809	40827	40845	40863	40881	40899	40917	40935
7	40953	40971	40989	41007	41025	41043	41061	41079	41097	41115
8	41133	41151	41169	41187	41205	41223	41241	41259	41277	41295
9	41313	41331	41349	41367	41385	41403	41421	41439	41457	41475
0	2.	41497	2.	41514	2.	41531	2.	41547	2.	41564
1	41581	41598	41615	41632	41649	41666	41683	41699	41716	41733
2	41750	41767	41784	41801	41818	41835	41852	41869	41886	41903
3	41920	41937	41954	41971	41988	42005	42022	42039	42056	42073
4	42090	42107	42124	42141	42158	42175	42192	42209	42226	42243
5	42260	42277	42294	42311	42328	42345	42362	42379	42396	42413
6	42430	42447	42464	42481	42498	42515	42532	42549	42566	42583
7	42599	42616	42633	42650	42667	42684	42701	42718	42735	42752
8	42769	42786	42803	42820	42837	42854	42871	42888	42905	42922
9	42939	42956	42973	42990	43007	43024	43041	43058	43075	43092
0	2.	43136	2.	43152	2.	43168	2.	43185	2.	43201
1	43217	43233	43249	43265	43281	43297	43313	43329	43345	43361
2	43377	43393	43409	43425	43441	43457	43473	43489	43505	43521
3	43537	43553	43568	43584	43600	43616	43632	43648	43664	43680
4	43696	43712	43727	43743	43759	43775	43791	43807	43823	43838
5	43854	43870	43886	43902	43917	43933	43949	43965	43981	43996
6	44012	44028	44044	44059	44075	44091	44107	44122	44138	44154
7	44169	44185	44201	44217	44232	44248	44264	44279	44295	44311
8	44326	44342	44358	44373	44389	44404	44420	44436	44451	44467
9	44482	44498	44514	44529	44545	44560	44576	44591	44607	44623
0	2.	44639	2.	44655	2.	44671	2.	44687	2.	44703

A Table of Logarithms from 1 to 10,000.

No.	0	1	2	3	4	5	6	7	8	9
280	2. 44716	2. 44731	2. 44747	2. 44762	2. 44778	2. 44793	2. 44809	2. 44824	2. 44840	2. 44855
281	44871	44886	44901	44917	44932	44948	44963	44979	44994	45000
282	45025	45040	45056	45071	45086	45102	45117	45132	45148	45163
283	45179	45194	45209	45225	45240	45255	45271	45286	45301	45316
284	45332	45347	45362	45378	45393	45408	45423	45439	45454	45469
285	45484	45500	45515	45530	45545	45561	45576	45591	45606	45621
286	45637	45652	45667	45682	45697	45712	45728	45743	45760	45775
287	45788	45803	45818	45834	45849	45864	45879	45894	45909	45924
288	45939	45954	45969	45984	45999	46015	46030	46045	46060	46075
289	46090	46105	46120	46135	46150	46165	46180	46195	46210	46225
290	2. 46240	2. 46255	2. 46270	2. 46285	2. 46300	2. 46315	2. 46329	2. 46344	2. 46359	2. 46374
291	46389	46404	46419	46434	46449	46464	46479	46494	46508	46523
292	46538	46553	46568	46583	46598	46612	46627	46642	46657	46672
293	46687	46702	46716	46731	46746	46761	46776	46790	46805	46820
294	46835	46849	46864	46879	46894	46908	46923	46938	46953	46967
295	46982	46997	47012	47026	47041	47056	47070	47085	47100	47115
296	47129	47144	47158	47173	47188	47202	47217	47232	47246	47261
297	47276	47290	47305	47319	47334	47349	47363	47378	47392	47407
298	47422	47436	47451	47465	47480	47494	47510	47523	47538	47552
299	47567	47582	47596	47611	47625	47640	47654	47669	47683	47698
300	2. 47712	2. 47727	2. 47741	2. 47755	2. 47770	2. 47784	2. 47799	2. 47813	2. 47828	2. 47842
301	47857	47871	47885	47900	47914	47929	47943	47957	47972	47986
302	48001	48015	48029	48044	48058	48072	48087	48101	48116	48130
303	48144	48159	48173	48187	48202	48216	48230	48244	48259	48273
304	48287	48302	48316	48330	48344	48359	48373	48387	48401	48416
305	48430	48444	48458	48473	48487	48501	48515	48529	48544	48558
306	48572	48586	48600	48615	48629	48643	48657	48671	48685	48700
307	48714	48728	48742	48756	48770	48784	48799	48813	48827	48841
308	48855	48869	48883	48897	48911	48925	48940	48954	48968	48982
309	48996	49010	49024	49038	49052	49066	49080	49094	49108	49122
310	2. 49136	2. 49150	2. 49164	2. 49178	2. 49192	2. 49206	2. 49220	2. 49234	2. 49248	2. 49262
311	49276	49290	49304	49318	49332	49346	49360	49374	49388	49402
312	49415	49429	49443	49457	49471	49485	49499	49513	49527	49541
313	49554	49568	49582	49596	49610	49624	49638	49651	49665	49679
314	49693	49707	49721	49734	49748	49762	49776	49790	49803	49817
315	49831	49845	49859	49872	49886	49900	49914	49927	49941	49955
316	49969	49982	49996	50010	50024	50037	50051	50065	50078	50092
317	50106	50120	50134	50147	50161	50174	50188	50202	50215	50229
318	50243	50256	50270	50284	50297	50311	50325	50338	50352	50365
319	50379	50393	50406	50420	50433	50447	50461	50474	50488	50501
320	2. 50515	2. 50529	2. 50542	2. 50556	2. 50569	2. 50583	2. 50596	2. 50610	2. 50623	2. 50637
321	50650	50664	50677	50691	50705	50718	50732	50745	50759	50772
322	50786	50799	50812	50826	50839	50853	50866	50880	50893	50907
323	50920	50934	50947	50961	50974	50987	51001	51014	51028	51041
324	51054	51068	51081	51095	51108	51121	51135	51148	51162	51175
325	51188	51202	51215	51228	51242	51255	51268	51282	51295	51308
326	51322	51335	51348	51362	51375	51388	51402	51415	51428	51441
327	51455	51468	51481	51495	51508	51521	51534	51548	51561	51574
328	51587	51601	51614	51627	51640	51653	51667	51680	51693	51706
329	51720	51733	51746	51759	51772	51785	51799	51812	51825	51838
330	2. 51851	2. 51864	2. 51878	2. 51891	2. 51904	2. 51917	2. 51930	2. 51943	2. 51956	2. 51970
331	51983	51996	52009	52022	52035	52048	52061	52074	52088	52101
332	52114	52127	52140	52153	52166	52179	52192	52205	52218	52231
333	52244	52257	52270	52283	52297	52310	52323	52336	52349	52362
334	52375	52388	52401	52414	52427	52440	52453	52466	52478	52491
335	52504	52517	52530	52543	52556	52569	52582	52595	52608	52621
336	52634	52647	52660	52673	52686	52698	52711	52724	52737	52750
337	52763	52776	52789	52802	52814	52827	52840	52853	52866	52879
338	52892	52904	52917	52930	52943	52956	52969	52981	52994	53007
339	53020	53033	53046	53058	53071	53084	53097	53109	53122	53135

A Table of Logarithms from 1 to 10,000.

0	1	2	3	4	5	6	7	8	9
2. 53148	2. 53161	2. 53173	2. 53186	2. 53199	2. 53212	2. 53224	2. 53237	2. 53250	2. 53263
53275	53288	53301	53314	53326	53339	53352	53364	53377	53390
53403	53415	53428	53441	53453	53466	53479	53491	53504	53517
53529	53542	53555	53567	53580	53593	53605	53618	53631	53643
53656	53668	53681	53694	53706	53719	53731	53744	53757	53769
53782	53794	53807	53820	53832	53845	53857	53870	53882	53895
53908	53920	53933	53945	53958	53970	53983	53995	54008	54020
54033	54045	54058	54070	54083	54095	54108	54120	54133	54145
54158	54170	54183	54195	54208	54220	54233	54245	54258	54270
54282	54295	54307	54320	54332	54345	54357	54370	54382	54394
2. 54407	2. 54419	2. 54432	2. 54444	2. 54456	2. 54469	2. 54481	2. 54494	2. 54506	2. 54518
54531	54543	54555	54568	54580	54592	54605	54617	54630	54642
54654	54667	54679	54691	54704	54716	54728	54740	54753	54765
54777	54790	54802	54814	54827	54839	54851	54863	54876	54888
54900	54913	54925	54937	54949	54962	54974	54986	54998	55011
55023	55035	55047	55059	55072	55084	55096	55108	55121	55133
55145	55157	55169	55182	55194	55206	55218	55230	55242	55255
55267	55279	55291	55303	55315	55328	55340	55352	55364	55376
55388	55400	55413	55425	55437	55449	55461	55473	55485	55497
55509	55521	55534	55546	55558	55570	55582	55594	55606	55618
2. 55630	2. 55642	2. 55654	2. 55666	2. 55678	2. 55690	2. 55703	2. 55715	2. 55727	2. 55739
55751	55763	55775	55787	55799	55811	55823	55835	55847	55859
55871	55883	55895	55907	55919	55931	55943	55955	55967	55979
55991	56003	56015	56026	56038	56050	56062	56074	56086	56098
56110	56122	56134	56146	56158	56170	56182	56194	56205	56217
56229	56241	56253	56265	56277	56289	56301	56312	56324	56336
56348	56360	56372	56384	56395	56407	56419	56431	56443	56455
56467	56478	56490	56502	56514	56526	56537	56549	56561	56573
56585	56597	56608	56620	56632	56644	56655	56667	56679	56691
56703	56714	56726	56738	56750	56761	56773	56785	56797	56808
2. 56820	2. 56832	2. 56844	2. 56855	2. 56867	2. 56879	2. 56890	2. 56902	2. 56914	2. 56926
56937	56949	56961	56972	56984	56996	57008	57019	57031	57043
57054	57066	57078	57089	57101	57113	57124	57136	57148	57159
57171	57182	57194	57206	57217	57229	57241	57252	57264	57275
57287	57299	57310	57322	57334	57345	57357	57368	57380	57391
57403	57415	57426	57438	57449	57461	57473	57484	57496	57507
57519	57530	57542	57553	57565	57576	57588	57600	57611	57623
57634	57646	57657	57669	57680	57692	57703	57715	57726	57738
57749	57761	57772	57784	57795	57807	57818	57829	57841	57852
57864	57875	57887	57898	57910	57921	57933	57944	57955	57967
2. 57978	2. 57990	2. 58001	2. 58013	2. 58024	2. 58035	2. 58047	2. 58058	2. 58070	2. 58081
58092	58104	58115	58127	58138	58149	58161	58172	58184	58195
58206	58218	58229	58240	58252	58263	58274	58286	58297	58308
58320	58331	58342	58354	58365	58376	58388	58399	58410	58422
58433	58444	58456	58467	58478	58490	58501	58512	58523	58535
58546	58557	58569	58580	58591	58602	58614	58625	58636	58647
58659	58670	58681	58692	58704	58715	58726	58737	58749	58760
58771	58782	58793	58805	58816	58827	58838	58850	58861	58872
58883	58894	58905	58917	58928	58939	58950	58961	58973	58984
58995	59006	59017	59028	59040	59051	59062	59073	59084	59095
2. 59106	2. 59118	2. 59129	2. 59140	2. 59151	2. 59162	2. 59173	2. 59184	2. 59195	2. 59207
59218	59229	59240	59251	59262	59273	59284	59295	59306	59317
59329	59340	59351	59362	59373	59384	59395	59406	59417	59428
59439	59450	59461	59472	59483	59494	59505	59516	59528	59539
59550	59561	59572	59583	59594	59605	59616	59627	59638	59649
59660	59671	59682	59693	59704	59714	59726	59737	59748	59758
59769	59780	59791	59802	59813	59824	59835	59846	59857	59868
59879	59890	59901	59912	59923	59934	59945	59956	59966	59977
59988	59999	60010	60021	60032	60043	60054	60065	60075	60086
60097	60108	60119	60130	60141	60152	60163	60173	60184	60195

A Table of Logarithms from 1 to 10.000.

No.	0	1	2	3	4	5	6	7	8	9
400	2.60206	2.60217	2.60228	2.60239	2.60249	2.60260	2.60271	2.60282	2.60293	2.60304
401	60314	60325	60336	60347	60358	60368	60379	60390	60401	60412
402	60422	60433	60444	60455	60466	60477	60487	60498	60509	60520
403	60530	60541	60552	60563	60574	60584	60595	60606	60617	60627
404	60638	60649	60660	60670	60681	60692	60703	60713	60724	60735
405	60745	60756	60767	60778	60788	60799	60810	60820	60831	60841
406	60853	60863	60874	60885	60895	60906	60917	60927	60938	60949
407	60959	60970	60981	60991	61002	61013	61023	61034	61045	61055
408	61066	61077	61087	61098	61109	61119	61130	61140	61151	61162
409	61172	61183	61194	61204	61215	61225	61236	61247	61257	61268
410	2.61278	2.61289	2.61300	2.61310	2.61321	2.61331	2.61342	2.61352	2.61363	2.61374
411	61384	61395	61405	61416	61426	61437	61447	61458	61469	61479
412	61490	61500	61511	61521	61532	61542	61553	61563	61574	61584
413	61595	61605	61616	61626	61637	61647	61658	61668	61679	61689
414	61700	61710	61721	61731	61742	61752	61763	61773	61784	61794
415	61805	61815	61826	61836	61847	61857	61867	61878	61888	61899
416	61909	61920	61930	61941	61951	61961	61972	61982	61993	62003
417	62014	62024	62034	62045	62055	62066	62076	62086	62097	62107
418	62118	62128	62138	62149	62159	62169	62180	62190	62201	62211
419	62221	62232	62242	62252	62263	62273	62283	62294	62304	62315
420	2.62325	2.62335	2.62346	2.62356	2.62366	2.62377	2.62387	2.62397	2.62408	2.62418
421	62428	62438	62449	62459	62469	62480	62490	62500	62511	62521
422	62531	62541	62552	62562	62572	62583	62593	62603	62613	62624
423	62634	62644	62655	62665	62675	62685	62696	62706	62716	62726
424	62737	62747	62757	62767	62777	62788	62798	62808	62818	62829
425	62839	62849	62859	62869	62880	62890	62900	62910	62921	62931
426	62941	62951	62961	62971	62982	62992	63002	63012	63022	63033
427	63042	63053	63063	63073	63083	63094	63104	63114	63124	63134
428	63144	63154	63165	63175	63185	63195	63205	63215	63225	63236
429	63246	63256	63266	63276	63286	63296	63306	63316	63327	63337
430	2.63347	2.63357	2.63367	2.63377	2.63387	2.63397	2.63407	2.63417	2.63428	2.63438
431	63448	63458	63468	63478	63488	63498	63508	63518	63528	63537
432	63548	63558	63568	63578	63588	63599	63609	63619	63629	63639
433	63649	63659	63669	63679	63689	63699	63709	63719	63729	63739
434	63749	63759	63769	63779	63789	63799	63809	63819	63829	63839
435	63849	63859	63869	63879	63889	63899	63909	63919	63929	63939
436	63949	63959	63969	63978	63988	63998	64008	64018	64028	64038
437	64048	64058	64068	64078	64088	64098	64108	64118	64128	64137
438	64147	64157	64167	64177	64187	64197	64207	64217	64227	64237
439	64246	64256	64266	64276	64286	64296	64306	64316	64325	64335
440	2.64345	2.64355	2.64365	2.64375	2.64385	2.64395	2.64404	2.64414	2.64424	2.64434
441	64444	64454	64463	64473	64483	64493	64503	64513	64523	64532
442	64542	64552	64562	64572	64581	64591	64601	64611	64621	64631
443	64640	64650	64660	64670	64680	64689	64699	64709	64719	64728
444	64738	64748	64758	64768	64777	64787	64797	64807	64816	64826
445	64836	64846	64855	64865	64875	64885	64894	64904	64914	64924
446	64933	64943	64953	64963	64972	64982	64992	65002	65011	65021
447	65031	65040	65050	65060	65070	65079	65089	65099	65108	65118
448	65128	65137	65147	65157	65167	65176	65186	65196	65205	65215
449	65225	65234	65244	65254	65263	65273	65283	65292	65302	65312
450	2.65321	2.65331	2.65340	2.65350	2.65360	2.65369	2.65379	2.65389	2.65398	2.65408
451	65418	65427	65437	65446	65456	65466	65475	65485	65495	65504
452	65514	65523	65533	65543	65552	65562	65571	65581	65591	65600
453	65610	65619	65629	65639	65648	65658	65667	65677	65686	65696
454	65706	65715	65725	65734	65744	65753	65763	65772	65782	65792
455	65801	65811	65820	65830	65839	65849	65858	65868	65877	65887
456	65896	65906	65915	65925	65935	65944	65954	65963	65973	65982
457	65992	66001	66011	66020	66030	66039	66049	66058	66068	66077
458	66086	66096	66105	66115	66124	66134	66143	66153	66162	66172
459	66181	66191	66200	66210	66219	66228	66238	66247	66257	66267

A Table of Logarithms from 1 to 10,000.

	0	1	2	3	4	5	6	7	8	9
0	2.66276	2.66285	2.66295	2.66304	2.66313	2.66323	2.66332	2.66342	2.66351	2.66361
1	66370	66379	66389	66398	66408	66417	66427	66436	66445	66455
2	66464	66474	66483	66492	66502	66511	66521	66530	66539	66549
3	66558	66567	66577	66586	66596	66605	66614	66624	66633	66642
4	66652	66661	66670	66680	66689	66699	66708	66717	66727	66736
5	66745	66755	66764	66773	66783	66792	66801	66811	66820	66829
6	66839	66848	66857	66866	66876	66885	66894	66904	66913	66922
7	66932	66941	66950	66960	66969	66978	66987	66997	67006	67015
8	67025	67034	67043	67052	67062	67071	67080	67089	67099	67108
9	67117	67126	67136	67145	67154	67164	67173	67182	67191	67200
0	2.67210	2.67219	2.67228	2.67237	2.67247	2.67256	2.67265	2.67274	2.67284	2.67293
1	67302	67311	67320	67330	67339	67348	67357	67367	67376	67385
2	67394	67403	67413	67422	67431	67440	67449	67459	67468	67477
3	67486	67495	67504	67514	67523	67532	67541	67550	67559	67569
4	67578	67587	67596	67605	67614	67624	67633	67642	67651	67660
5	67669	67678	67688	67697	67706	67715	67724	67733	67742	67752
6	67761	67770	67779	67788	67797	67806	67815	67824	67834	67843
7	67852	67861	67870	67879	67888	67897	67906	67915	67925	67934
8	67943	67952	67961	67970	67979	67988	67997	68006	68015	68024
9	68033	68043	68052	68061	68070	68079	68088	68097	68106	68115
0	2.68124	2.68133	2.68142	2.68151	2.68160	2.68169	2.68178	2.68187	2.68196	2.68205
1	68214	68223	68233	68242	68251	68260	68269	68278	68287	68296
2	68305	68314	68323	68332	68341	68350	68359	68368	68377	68386
3	68395	68404	68413	68422	68431	68440	68449	68458	68467	68476
4	68484	68493	68502	68511	68520	68529	68538	68547	68556	68565
5	68574	68583	68592	68601	68610	68619	68628	68637	68646	68655
6	68664	68673	68681	68690	68699	68708	68717	68726	68735	68744
7	68753	68762	68771	68780	68788	68797	68806	68815	68824	68833
8	68842	68851	68860	68869	68878	68886	68895	68904	68913	68922
9	68931	68940	68948	68957	68966	68975	68984	68993	69002	69011
0	2.69020	2.69028	2.69037	2.69046	2.69055	2.69064	2.69073	2.69082	2.69090	2.69099
1	69108	69117	69126	69135	69143	69152	69161	69170	69179	69188
2	69196	69205	69214	69223	69232	69241	69249	69258	69267	69276
3	69285	69293	69302	69311	69320	69329	69337	69346	69355	69364
4	69373	69381	69390	69399	69408	69417	69425	69434	69443	69452
5	69460	69469	69478	69487	69496	69504	69513	69522	69531	69539
6	69548	69557	69566	69574	69583	69592	69601	69609	69618	69627
7	69636	69644	69653	69662	69671	69679	69688	69697	69705	69714
8	69723	69732	69740	69749	69758	69766	69775	69784	69793	69801
9	69810	69819	69827	69836	69845	69853	69862	69871	69880	69888
0	2.69897	2.69906	2.69914	2.69923	2.69932	2.69940	2.69949	2.69958	2.69966	2.69975
1	69984	69992	70001	70010	70018	70027	70036	70044	70053	70062
2	70070	70079	70088	70096	70105	70114	70122	70131	70139	70148
3	70157	70165	70174	70183	70191	70200	70209	70217	70226	70234
4	70243	70252	70260	70269	70277	70286	70295	70303	70312	70320
5	70329	70338	70346	70355	70363	70372	70381	70389	70398	70406
6	70415	70424	70432	70441	70449	70458	70466	70475	70484	70492
7	70501	70509	70518	70526	70535	70544	70552	70561	70569	70578
8	70586	70595	70603	70612	70620	70629	70638	70646	70655	70663
9	70672	70680	70689	70697	70703	70714	70723	70731	70740	70748
0	2.70757	2.70765	2.70774	2.70783	2.70791	2.70800	2.70808	2.70817	2.70825	2.70834
1	70842	70851	70859	70868	70876	70885	70893	70901	70910	70918
2	70927	70935	70944	70952	70961	70969	70978	70986	70995	71003
3	71012	71020	71029	71037	71045	71054	71062	71071	71079	71088
4	71096	71105	71113	71122	71130	71138	71147	71155	71164	71172
5	71181	71189	71198	71206	71214	71223	71231	71240	71248	71256
6	71265	71273	71282	71290	71299	71307	71315	71324	71332	71341
7	71349	71357	71366	71374	71383	71391	71399	71408	71416	71425
8	71433	71441	71450	71458	71466	71475	71483	71492	71500	71508
9	71517	71525	71533	71542	71550	71559	71567	71575	71584	71592

A Table of Logarithms from 1 10.000.

No.	0	1	2	3	4	5	6	7	8	9
520	2.71600	2.71609	2.71617	2.71625	2.71634	2.71642	2.71650	2.71659	2.71667	2.71675
521	71684	71692	71700	71709	71717	71725	71734	71742	71750	71758
522	71767	71775	71784	71792	71800	71809	71817	71825	71834	71842
523	71850	71858	71867	71875	71883	71892	71900	71908	71916	71925
524	71933	71941	71950	71958	71966	71974	71983	71991	71999	72008
525	72016	72024	72032	72041	72049	72057	72065	72074	72082	72090
526	72099	72107	72115	72123	72132	72140	72148	72156	72165	72173
527	72181	72189	72197	72206	72214	72222	72230	72239	72247	72255
528	72263	72272	72280	72288	72296	72304	72313	72321	72329	72337
529	72346	72354	72362	72370	72378	72387	72395	72403	72411	72419
530	2.72428	2.72436	2.72444	2.72452	2.72460	2.72468	2.72477	2.72485	2.72493	2.72501
531	72509	72518	72526	72534	72542	72550	72558	72567	72575	72583
532	72591	72599	72607	72616	72624	72632	72640	72648	72656	72664
533	72673	72681	72689	72697	72705	72713	72722	72730	72738	72746
534	72754	72762	72770	72778	72787	72795	72803	72811	72819	72827
535	72835	72843	72852	72860	72868	72876	72884	72892	72900	72908
536	72916	72925	72933	72941	72949	72957	72965	72973	72981	72989
537	72997	73005	73014	73022	73030	73038	73046	73054	73062	73070
538	73078	73086	73094	73102	73110	73119	73127	73135	73143	73151
539	73159	73167	73175	73183	73191	73199	73207	73215	73223	73231
540	2.73239	2.73247	2.73255	2.73263	2.73271	2.73280	2.73288	2.73296	2.73304	2.73312
541	73320	73328	73336	73344	73352	73360	73368	73376	73384	73392
542	73400	73408	73416	73424	73432	73440	73448	73456	73464	73472
543	73480	73488	73496	73504	73512	73520	73528	73536	73544	73552
544	73560	73568	73576	73584	73592	73600	73608	73616	73624	73632
545	73640	73648	73656	73664	73671	73679	73687	73695	73703	73711
546	73720	73727	73735	73743	73751	73759	73767	73775	73783	73791
547	73799	73807	73815	73822	73830	73838	73846	73854	73862	73870
548	73878	73886	73894	73902	73910	73918	73926	73933	73941	73949
549	73957	73965	73973	73981	73989	73997	74005	74013	74020	74028
550	2.74036	2.74044	2.74052	2.74060	2.74068	2.74076	2.74084	2.74091	2.74099	2.74107
551	74115	74123	74131	74139	74147	74155	74162	74170	74178	74186
552	74194	74202	74210	74217	74225	74233	74241	74249	74257	74265
553	74272	74280	74288	74296	74304	74312	74320	74327	74335	74343
554	74351	74359	74367	74374	74382	74390	74398	74406	74414	74422
555	74429	74437	74445	74453	74461	74468	74476	74484	74492	74500
556	74507	74515	74523	74531	74539	74546	74554	74562	74570	74578
557	74585	74593	74601	74609	74617	74624	74632	74640	74648	74656
558	74663	74671	74679	74687	74694	74702	74710	74718	74726	74734
559	74741	74749	74757	74764	74772	74780	74788	74795	74803	74811
560	2.74810	2.74827	2.74834	2.74842	2.74850	2.74858	2.74865	2.74873	2.74881	2.74888
561	74896	74904	74912	74919	74927	74935	74943	74950	74958	74966
562	74974	74981	74989	74997	75004	75012	75020	75028	75035	75043
563	75051	75059	75066	75074	75082	75089	75097	75105	75112	75120
564	75128	75136	75143	75151	75159	75166	75174	75182	75189	75197
565	75205	75212	75220	75228	75236	75243	75251	75259	75266	75274
566	75282	75289	75297	75305	75312	75320	75328	75335	75343	75351
567	75358	75366	75374	75381	75389	75397	75404	75412	75419	75427
568	75435	75442	75450	75458	75465	75473	75481	75488	75496	75504
569	75511	75519	75526	75534	75542	75549	75557	75565	75572	75580
570	2.75587	2.75595	2.75603	2.75610	2.75618	2.75626	2.75633	2.75641	2.75648	2.75656
571	75664	75671	75679	75686	75694	75702	75709	75717	75724	75732
572	75740	75747	75755	75762	75770	75777	75785	75793	75800	75808
573	75815	75823	75831	75838	75846	75853	75861	75868	75876	75884
574	75891	75899	75906	75914	75921	75929	75937	75944	75952	75959
575	75967	75974	75982	75989	75997	76005	76012	76020	76027	76035
576	76042	76050	76057	76065	76072	76080	76087	76095	76102	76110
577	76118	76125	76133	76140	76148	76155	76163	76170	76178	76186
578	76193	76200	76208	76215	76223	76230	76238	76245	76253	76261
579	76268	76275	76283	76290	76298	76305	76313	76320	76328	76336

A Table of Logarithms from 1 to 10.0000.

0	1	2	3	4	5	6	7	8	9
2.76343	2.76350	2.76358	2.76365	2.76373	2.76380	2.76388	2.76395	2.76403	2.76410
76418	76425	76433	76440	76447	76455	76462	76470	76477	76485
76492	76500	76507	76515	76522	76530	76537	76544	76552	76559
76567	76574	76582	76589	76597	76604	76611	76619	76626	76634
76641	76649	76656	76664	76671	76678	76686	76693	76701	76708
76716	76723	76730	76738	76745	76753	76760	76767	76775	76782
76790	76797	76804	76812	76819	76827	76834	76842	76849	76856
76864	76871	76879	76886	76893	76901	76908	76916	76923	76930
76938	76945	76952	76960	76967	76975	76982	76989	76997	77004
77011	77019	77026	77034	77041	77048	77056	77063	77070	77078
2.77085	2.77093	2.77100	2.77107	2.77115	2.77122	2.77129	2.77137	2.77144	2.77151
77159	77166	77173	77181	77188	77195	77203	77210	77217	77225
77232	77239	77247	77254	77261	77269	77276	77283	77291	77298
77305	77313	77320	77327	77335	77342	77349	77357	77364	77371
77379	77386	77393	77401	77408	77415	77422	77430	77437	77444
77452	77459	77466	77474	77481	77488	77495	77503	77510	77517
77525	77532	77539	77546	77554	77561	77568	77575	77583	77590
77597	77605	77612	77619	77626	77634	77641	77648	77656	77663
77670	77677	77685	77692	77699	77706	77714	77721	77728	77735
77743	77750	77757	77764	77772	77779	77786	77793	77801	77808
2.77815	2.77822	2.77830	2.77837	2.77844	2.77851	2.77858	2.77866	2.77873	2.77880
77887	77895	77902	77909	77916	77924	77931	77938	77945	77952
77960	77967	77974	77981	77988	77996	78003	78010	78017	78024
78032	78039	78046	78053	78060	78068	78075	78082	78089	78096
78104	78111	78118	78125	78132	78140	78147	78154	78161	78168
78175	78183	78190	78197	78204	78211	78219	78226	78233	78240
78247	78254	78262	78269	78276	78283	78290	78297	78305	78312
78319	78326	78333	78340	78347	78355	78362	78369	78376	78383
78390	78397	78405	78412	78419	78426	78433	78440	78447	78455
78462	78469	78476	78483	78490	78497	78504	78512	78519	78526
2.78533	2.78540	2.78547	2.78554	2.78561	2.78569	2.78576	2.78583	2.78590	2.78597
78604	78611	78618	78625	78632	78640	78647	78654	78661	78668
78675	78682	78689	78696	78703	78711	78718	78725	78732	78739
78746	78753	78760	78767	78774	78781	78788	78796	78803	78810
78817	78824	78831	78838	78845	78852	78859	78866	78873	78880
78887	78895	78902	78909	78915	78923	78930	78937	78944	78951
78958	78965	78972	78979	78986	78993	79000	79007	79014	79021
79028	79036	79043	79050	79057	79064	79071	79078	79085	79092
79099	79106	79113	79120	79127	79134	79141	79148	79155	79162
79169	79176	79183	79190	79197	79204	79211	79218	79225	79232
2.79239	2.79246	2.79253	2.79260	2.79267	2.79274	2.79281	2.79288	2.79295	2.79302
79309	79316	79323	79330	79337	79344	79351	79358	79365	79372
79379	79386	79393	79400	79407	79414	79421	79428	79435	79442
79449	79456	79463	79470	79477	79484	79491	79498	79504	79511
79518	79525	79532	79539	79546	79553	79560	79567	79574	79581
79588	79595	79602	79609	79616	79623	79630	79637	79644	79650
79657	79664	79671	79678	79685	79692	79699	79706	79713	79720
79727	79734	79741	79747	79754	79761	79768	79775	79782	79789
79796	79803	79810	79817	79824	79830	79837	79844	79851	79858
79865	79872	79879	79886	79893	79900	79906	79913	79920	79927
2.79934	2.79941	2.79948	2.79955	2.79962	2.79968	2.79975	2.79982	2.79989	2.79996
80003	80010	80017	80024	80030	80037	80044	80051	80058	80065
80072	80079	80085	80092	80099	80106	80113	80120	80127	80133
80140	80147	80154	80161	80168	80175	80181	80188	80195	80202
80209	80216	80223	80229	80236	80243	80250	80257	80264	80270
80277	80284	80291	80298	80305	80312	80318	80325	80332	80339
80346	80352	80359	80366	80373	80380	80387	80393	80400	80407
80414	80421	80428	80434	80441	80448	80455	80462	80468	80475
80482	80489	80496	80502	80509	80516	80523	80530	80536	80543
80550	80557	80564	80570	80577	80584	80591	80598	80605	80611

A Table of Logarithms from 1 to 10,000.

No.	0	1	2	3	4	5	6	7	8	9
640	2.80618	2.80625	2.80632	2.80638	2.80645	2.80652	2.80659	2.80665	2.80672	2.8067
641	80636	80693	80699	80706	80713	80720	80726	80733	80740	8074
642	80753	80760	80767	80774	80781	80787	80794	80801	80807	8081
643	80821	80828	80835	80841	80848	80855	80862	80868	80875	8088
644	80889	80895	80902	80909	80915	80922	80929	80936	80942	809
645	80956	80963	80969	80976	80983	80990	80996	81003	81010	810
646	81023	81030	81037	81043	81050	81057	81064	81070	81077	8108
647	81090	81097	81104	81111	81117	81124	81131	81137	81144	8115
648	81157	81164	81171	81178	81184	81191	81198	81204	81211	8121
649	81224	81231	81238	81244	81251	81258	81265	81271	81278	8128
650	2.81291	2.81298	2.81305	2.81311	2.81318	2.81325	2.81331	2.81338	2.81345	2.8135
651	81358	81365	81371	81378	81385	81391	81398	81405	81411	8141
652	81425	81431	81438	81445	81451	81458	81465	81471	81478	8148
653	81491	81498	81505	81511	81518	81525	81531	81538	81544	8155
654	81553	81560	81567	81573	81584	81591	81598	81604	81611	8161
655	81624	81631	81637	81644	81651	81657	81664	81670	81677	8168
656	81690	81697	81704	81710	81717	81723	81730	81737	81743	8175
657	81756	81763	81770	81776	81783	81790	81796	81803	81809	8181
658	81823	81829	81836	81842	81849	81856	81862	81869	81875	8188
659	81888	81895	81902	81908	81915	81921	81928	81935	81941	8194
660	2.81954	2.81961	2.81967	2.81974	2.81981	2.81987	2.81994	2.82000	2.82007	2.8201
661	82020	82027	82033	82040	82046	82053	82059	82066	82073	8207
662	82086	82092	82099	82105	82112	82119	82125	82132	82138	8214
663	82151	82158	82164	82171	82177	82184	82191	82197	82204	8221
664	82217	82223	82230	82236	82243	82249	82256	82263	82269	8227
665	82282	82289	82295	82302	82308	82315	82321	82328	82334	8234
666	82347	82354	82360	82367	82373	82380	82386	82393	82400	8240
667	82413	82419	82426	82432	82439	82445	82452	82458	82464	8247
668	82478	82484	82491	82497	82504	82510	82517	82523	82530	8253
669	82543	82549	82556	82562	82569	82575	82581	82588	82594	8260
670	2.82607	2.82614	2.82620	2.82627	2.82633	2.82640	2.82646	2.82653	2.82659	2.8266
671	82672	82679	82685	82692	82698	82705	82711	82717	82724	8273
672	82737	82743	82750	82756	82763	82769	82776	82782	82789	8279
673	82801	82808	82814	82821	82827	82834	82840	82847	82853	8285
674	82866	82872	82879	82885	82892	82898	82905	82911	82917	8292
675	82930	82937	82943	82950	82956	82962	82969	82975	82982	8298
676	82995	83001	83007	83014	83020	83027	83033	83040	83046	8305
677	83059	83065	83072	83078	83084	83091	83097	83104	83110	8311
678	83123	83129	83136	83142	83149	83155	83161	83168	83174	8318
679	83187	83193	83200	83206	83212	83219	83225	83232	83238	8324
680	2.83251	2.83257	2.83264	2.83270	2.83276	2.83283	2.83289	2.83296	2.83302	2.8330
681	83315	83321	83327	83334	83340	83347	83353	83359	83366	8337
682	83378	83385	83391	83397	83404	83410	83417	83423	83429	8343
683	83442	83448	83455	83461	83467	83474	83480	83487	83493	8349
684	83506	83512	83518	83525	83531	83537	83544	83550	83556	8356
685	83569	83575	83582	83588	83594	83601	83607	83613	83620	8362
686	83632	83639	83645	83651	83658	83664	83670	83677	83683	8368
687	83696	83702	83708	83715	83721	83727	83734	83740	83746	8375
688	83759	83765	83771	83778	83784	83790	83797	83803	83809	8381
689	83822	83828	83834	83841	83847	83853	83860	83866	83872	8387
690	2.83885	2.83891	2.83897	2.83904	2.83910	2.83916	2.83923	2.83929	2.83935	2.8394
691	83948	83954	83960	83967	83973	83979	83985	83992	83998	8400
692	84011	84017	84023	84029	84036	84042	84048	84054	84061	8406
693	84073	84080	84086	84092	84098	84105	84111	84117	84123	8413
694	84136	84142	84148	84155	84161	84167	84173	84180	84186	8419
695	84198	84205	84211	84217	84223	84230	84236	84242	84248	8425
696	84261	84267	84273	84280	84286	84292	84298	84305	84311	8431
697	84323	84329	84336	84342	84349	84354	84361	84367	84373	8437
698	84385	84392	84398	84404	84410	84417	84423	84429	84435	8444
699	84448	84454	84460	84466	84473	84479	84485	84491	84497	8450

A Table of Logarithms from 1 to 10,000.

No	0	1	2	3	4	5	6	7	8	9
700	2.84510	2.84516	2.84522	2.84528	2.84535	2.84541	2.84547	2.84553	2.84559	2.84566
701	84572	84578	84584	84590	84596	84602	84609	84615	84621	84627
702	84634	84640	84646	84652	84658	84665	84671	84677	84683	84689
703	84695	84702	84708	84714	84720	84726	84733	84739	84745	84751
704	84757	84763	84770	84776	84782	84788	84794	84800	84807	84813
705	84819	84825	84831	84837	84843	84850	84856	84862	84868	84874
706	84880	84887	84893	84899	84905	84911	84917	84923	84930	84936
707	84942	84948	84954	84960	84966	84973	84979	84985	84991	84997
708	85003	85009	85016	85022	85028	85034	85040	85046	85052	85058
709	85065	85071	85077	85083	85089	85095	85101	85107	85114	85120
710	2.85126	2.85132	2.85138	2.85144	2.85150	2.85156	2.85162	2.85169	2.85175	2.85181
711	85187	85193	85199	85205	85211	85217	85224	85230	85236	85242
712	85248	85254	85260	85266	85272	85278	85285	85291	85297	85303
713	85309	85315	85321	85327	85333	85339	85345	85352	85358	85364
714	85370	85376	85382	85388	85394	85400	85406	85412	85418	85424
715	85431	85437	85443	85449	85455	85461	85467	85473	85479	85485
716	85491	85497	85503	85509	85516	85522	85528	85534	85540	85546
717	85552	85558	85564	85570	85576	85582	85588	85594	85600	85606
718	85612	85618	85624	85631	85637	85643	85649	85655	85661	85667
719	85673	85679	85685	85691	85697	85703	85709	85715	85721	85727
720	2.85733	2.85739	2.85745	2.85751	2.85757	2.85763	2.85769	2.85775	2.85781	2.85787
721	85793	85799	85806	85812	85818	85824	85830	85836	85842	85848
722	85854	85860	85866	85872	85878	85884	85890	85896	85902	85908
723	85914	85920	85926	85932	85938	85944	85950	85956	85962	85968
724	85974	85980	85986	85992	85998	86004	86010	86016	86022	86028
725	86034	86040	86046	86052	86058	86064	86070	86076	86082	86088
726	86094	86100	86106	86112	86118	86124	86130	86135	86141	86147
727	86153	86159	86165	86171	86177	86183	86189	86195	86201	86207
728	86213	86219	86225	86231	86237	86243	86249	86255	86261	86267
729	86273	86279	86285	86291	86297	86302	86308	86314	86320	86326
730	2.86332	2.86338	2.86344	2.86350	2.86356	2.86362	2.86368	2.86374	2.86380	2.86386
731	86392	86398	86404	86410	86415	86421	86427	86433	86439	86445
732	86451	86457	86463	86469	86475	86481	86487	86493	86498	86504
733	86510	86516	86522	86528	86534	86540	86546	86552	86558	86564
734	86570	86575	86581	86587	86593	86599	86605	86611	86617	86623
735	86629	86635	86640	86646	86652	86658	86664	86670	86676	86682
736	86688	86694	86700	86705	86711	86717	86723	86729	86735	86741
737	86747	86753	86758	86764	86770	86776	86782	86788	86794	86800
738	86806	86811	86817	86823	86829	86835	86841	86847	86853	86859
739	86864	86870	86876	86882	86888	86894	86900	86906	86911	86917
740	2.86923	2.86929	2.86935	2.86941	2.86947	2.86952	2.86958	2.86964	2.86970	2.86976
741	86982	86988	86993	86999	87005	87011	87017	87023	87029	87034
742	87040	87046	87052	87058	87064	87070	87075	87081	87087	87093
743	87099	87105	87111	87116	87122	87128	87134	87140	87146	87151
744	87157	87163	87169	87175	87181	87186	87192	87198	87204	87210
745	87216	87221	87227	87233	87239	87245	87251	87256	87262	87268
746	87274	87280	87285	87291	87297	87303	87309	87315	87320	87326
747	87332	87338	87344	87349	87355	87361	87367	87373	87378	87384
748	87390	87396	87402	87408	87413	87419	87425	87431	87437	87442
749	87448	87454	87460	87466	87471	87477	87483	87489	87494	87500
750	2.87506	2.87512	2.87518	2.87523	2.87529	2.87535	2.87541	2.87547	2.87552	2.87558
751	87564	87570	87576	87581	87587	87593	87599	87604	87610	87616
752	87622	87628	87633	87639	87645	87651	87656	87662	87668	87674
753	87679	87685	87691	87697	87702	87708	87714	87720	87726	87731
754	87737	87743	87749	87754	87760	87766	87772	87777	87783	87788
755	87795	87800	87806	87812	87818	87823	87829	87835	87841	87846
756	87852	87858	87864	87869	87875	87881	87887	87892	87898	87904
757	87910	87915	87921	87927	87932	87938	87944	87950	87955	87961
758	87967	87973	87978	87984	87990	87996	88001	88007	88013	88018
759	88024	88030	88036	88041	88047	88052	88058	88064	88070	88076

A Table of Logarithms from 1 to 10,000.

No.	0	1	2	3	4	5	6	7	8	9
760	2.88081	2.88087	2.88093	2.88098	2.88104	2.88110	2.88116	2.88121	2.88127	2.88133
761	88138	88144	88150	88156	88161	88167	88173	88179	88184	88190
762	88195	88201	88207	88213	88218	88224	88230	88235	88241	88247
763	88252	88258	88264	88269	88275	88281	88287	88292	88298	88304
764	88309	88315	88321	88326	88332	88338	88343	88349	88355	88360
765	88366	88372	88377	88383	88389	88394	88400	88406	88411	88417
766	88423	88428	88434	88440	88445	88451	88457	88462	88468	88474
767	88479	88485	88491	88496	88502	88508	88513	88519	88525	88530
768	88536	88542	88547	88553	88559	88564	88570	88576	88581	88587
769	88593	88598	88604	88610	88615	88621	88626	88632	88638	88643
770	2.88649	2.88655	2.88660	2.88666	2.88672	2.88677	2.88683	2.88688	2.88694	2.88700
771	88705	88711	88717	88722	88728	88734	88739	88745	88750	88756
772	88762	88767	88773	88779	88784	88790	88795	88801	88807	88812
773	88818	88824	88829	88835	88840	88846	88852	88857	88863	88868
774	88874	88880	88885	88891	88896	88902	88908	88913	88919	88925
775	88930	88936	88941	88947	88953	88958	88964	88969	88975	88981
776	88986	88992	88997	89003	89009	89014	89020	89025	89031	89036
777	89042	89048	89053	89059	89064	89070	89075	89081	89087	89092
778	89098	89103	89109	89115	89120	89126	89131	89137	89143	89148
779	89154	89159	89165	89170	89176	89182	89187	89193	89198	89204
780	2.89209	2.89215	2.89221	2.89226	2.89232	2.89237	2.89243	2.89248	2.89254	2.89259
781	89265	89271	89276	89282	89287	89293	89298	89304	89309	89315
782	89321	89326	89332	89337	89343	89348	89354	89359	89365	89371
783	89376	89382	89387	89393	89398	89404	89409	89415	89420	89426
784	89432	89437	89443	89448	89454	89459	89465	89470	89476	89481
785	89487	89492	89498	89504	89509	89515	89520	89526	89531	89537
786	89542	89548	89553	89559	89564	89570	89575	89581	89586	89592
787	89597	89603	89608	89614	89619	89625	89631	89636	89642	89647
788	89653	89658	89664	89669	89675	89680	89686	89691	89697	89702
789	89708	89713	89719	89724	89730	89735	89741	89746	89752	89757
790	2.89762	2.89768	2.89774	2.89779	2.89785	2.89790	2.89796	2.89801	2.89806	2.89812
791	89818	89823	89829	89834	89840	89845	89851	89856	89861	89867
792	89872	89878	89883	89889	89894	89900	89905	89911	89916	89922
793	89927	89933	89938	89944	89949	89955	89960	89966	89971	89977
794	89982	89987	89993	89998	90004	90009	90015	90020	90026	90031
795	90037	90042	90048	90053	90059	90064	90069	90075	90080	90085
796	90091	90097	90102	90108	90113	90119	90124	90129	90135	90141
797	90146	90151	90157	90162	90168	90173	90178	90184	90189	90195
798	90200	90206	90211	90217	90222	90227	90233	90238	90244	90249
799	90255	90260	90265	90271	90276	90282	90287	90293	90298	90304
800	2.90309	2.90314	2.90320	2.90325	2.90331	2.90336	2.90342	2.90347	2.90352	2.90358
801	90363	90369	90374	90379	90385	90390	90396	90401	90407	90412
802	90417	90423	90428	90434	90439	90444	90450	90455	90461	90466
803	90471	90477	90482	90488	90493	90499	90504	90509	90515	90520
804	90526	90531	90536	90542	90547	90553	90558	90563	90569	90574
805	90580	90585	90590	90596	90601	90606	90612	90617	90622	90628
806	90633	90639	90644	90650	90655	90660	90666	90671	90677	90682
807	90687	90693	90698	90703	90709	90714	90720	90725	90730	90736
808	90741	90746	90752	90757	90763	90768	90773	90779	90784	90789
809	90795	90800	90806	90811	90816	90822	90827	90832	90838	90843
810	2.90848	2.90854	2.90859	2.90865	2.90870	2.90875	2.90881	2.90886	2.90891	2.90897
811	90902	90907	90913	90918	90923	90929	90934	90939	90945	90950
812	90956	90961	90966	90972	90977	90982	90988	90993	90998	91004
813	91009	91014	91020	91025	91030	91036	91041	91046	91052	91057
814	91062	91068	91073	91078	91084	91089	91094	91100	91105	91110
815	91116	91121	91126	91132	91137	91142	91148	91153	91158	91164
816	91169	91174	91180	91185	91190	91196	91201	91206	91212	91217
817	91222	91227	91233	91238	91243	91249	91254	91259	91265	91270
818	91275	91281	91286	91291	91297	91302	91307	91312	91318	91323
819	91328	91334	91339	91344	91350	91355	91360	91365	91371	91376

A Table of Logarithms from 1 to 10,000.

	0	1	2	3	4	5	6	7	8	9
1	2.91381	2.91387	2.91392	2.91397	2.91403	5.91408	2.91413	2.91418	2.91424	2.91429
2	91434	91440	91445	91450	91455	91461	91466	91471	91477	91482
3	91487	91492	91498	91503	91508	91514	91519	91524	91529	91535
4	91540	91545	91550	91556	91561	91566	91572	91577	91582	91587
5	91593	91598	91603	91608	91614	91619	91624	91630	91635	91640
6	91645	91651	91656	91661	91666	91672	91677	91682	91687	91693
7	91698	91703	91708	91714	91719	91724	91729	91735	91740	91745
8	91750	91756	91761	91766	91772	91777	91782	91787	91792	91798
9	91803	91808	91813	91819	91824	91829	91834	91840	91845	91850
0	91855	91861	91866	91871	91876	91882	91887	91892	91897	91902
1	2.91908	2.91913	2.91918	2.91923	2.91929	2.91934	2.91939	2.91944	2.91950	2.91955
2	91960	91965	91970	91976	91981	91986	91991	91997	92002	92007
3	92012	92017	92023	92028	92033	92038	92044	92049	92054	92059
4	92064	92070	92075	92080	92085	92091	92096	92101	92106	92111
5	92117	92122	92127	92132	92137	92143	92148	92153	92158	92163
6	92169	92174	92179	92184	92189	92195	92200	92205	92210	92215
7	92221	92226	92231	92236	92241	92247	92252	92257	92262	92267
8	92272	92278	92283	92288	92293	92298	92304	92309	92314	92319
9	92324	92330	92335	92340	92345	92350	92355	92361	92366	92371
0	92376	92381	92386	92392	92397	92402	92407	92412	92418	92423
1	2.92428	2.92433	2.92438	2.92443	2.92449	2.92454	2.92459	2.92464	2.92469	2.92474
2	92480	92485	92490	92495	92500	92505	92511	92516	92521	92526
3	92531	92536	92541	92547	92552	92557	92562	92567	92572	92578
4	92583	92588	92593	92598	92603	92608	92614	92619	92624	92629
5	92634	92639	92644	92650	92655	92660	92665	92670	92675	92680
6	92686	92691	92696	92701	92706	92711	92716	92722	92727	92732
7	92737	92742	92747	92752	92758	92763	92768	92773	92778	92783
8	92788	92793	92799	92804	92809	92814	92819	92824	92829	92834
9	92840	92845	92850	92855	92860	92865	92870	92875	92880	92886
0	92891	92896	92901	92906	92911	92916	92921	92927	92932	92937
1	2.92942	2.92947	2.92952	2.92957	2.92962	2.92967	2.92972	2.92978	2.92983	2.92988
2	92993	92998	93003	93008	93013	93018	93024	93029	93034	93039
3	93044	93049	93054	93059	93064	93069	93074	93080	93085	93090
4	93095	93100	93105	93110	93115	93120	93125	93130	93136	93141
5	93146	93151	93156	93161	93166	93171	93176	93181	93186	93191
6	93197	93202	93207	93212	93217	93222	93227	93232	93237	93242
7	93247	93252	93257	93263	93268	93273	93278	93283	93288	93293
8	93298	93303	93308	93313	93318	93323	93328	93333	93339	93344
9	93349	93354	93359	93364	93369	93374	93379	93384	93389	93394
0	93399	93404	93409	93414	93419	93425	93430	93435	93440	93445
1	2.93450	2.93455	2.93460	2.93465	2.93470	2.93475	2.93480	2.93485	2.93490	2.93495
2	93500	93505	93510	93515	93520	93525	93531	93536	93541	93546
3	93551	93556	93561	93566	93571	93576	93581	93586	93591	93596
4	93601	93606	93611	93616	93621	93626	93631	93636	93641	93646
5	93651	93656	93661	93666	93671	93676	93681	93686	93692	93697
6	93702	93707	93712	93717	93722	93727	93732	93737	93742	93747
7	93752	93757	93762	93767	93772	93777	93782	93787	93792	93797
8	93802	93807	93812	93817	93822	93827	93832	93837	93842	93847
9	93852	93857	93862	93867	93872	93877	93882	93887	93892	93897
0	93902	93907	93912	93917	93922	93927	93932	93937	93942	93947
1	2.93952	2.93957	2.93962	2.93967	2.93972	2.93977	2.93982	2.93987	2.93992	2.93997
2	94002	94007	94012	94017	94022	94027	94032	94037	94042	94047
3	94052	94057	94062	94067	94072	94076	94081	94086	94091	94096
4	94101	94106	94111	94116	94121	94126	94131	94136	94141	94146
5	94151	94156	94161	94166	94171	94176	94181	94186	94191	94196
6	94201	94206	94211	94216	94221	94226	94230	94235	94240	94245
7	94250	94255	94260	94265	94270	94275	94280	94285	94290	94295
8	94300	94305	94310	94315	94320	94325	94330	94335	94340	94344
9	94349	94354	94359	94364	94369	94374	94379	94384	94389	94394
0	94399	94404	94409	94414	94419	94424	94428	94433	94438	94443

A Table of Logarithms from 1 to 10,000.

No.	0	1	2	3	4	5	6	7	8	9
880	2.94448	2.94453	2.94458	2.94463	2.94468	2.94473	2.94478	2.94483	2.94488	2.94493
881	94498	94502	94507	94512	94517	94522	94527	94532	94537	94542
882	94547	94552	94557	94562	94567	94571	94576	94581	94586	94591
883	94596	94601	94606	94611	94616	94621	94626	94630	94635	94640
884	94645	94650	94655	94660	94665	94670	94675	94680	94684	94689
885	94694	94699	94704	94709	94714	94719	94724	94729	94734	94738
886	94743	94748	94753	94758	94763	94768	94773	94778	94783	94787
887	94792	94797	94802	94807	94812	94817	94822	94827	94831	94836
888	94841	94846	94851	94856	94861	94866	94871	94875	94880	94885
889	94890	94895	94900	94905	94910	94915	94919	94924	94929	94934
890	2.94939	2.94944	2.94949	2.94953	2.94958	2.94963	2.94968	2.94973	2.94978	2.94983
891	94988	94993	94997	95002	95007	95012	95017	95022	95027	95031
892	95036	95041	95046	95051	95056	95061	95066	95070	95075	95080
893	95085	95090	95095	95100	95105	95109	95114	95119	95124	95129
894	95134	95139	95143	95148	95153	95158	95163	95168	95173	95177
895	95182	95187	95192	95197	95202	95207	95211	95216	95221	95226
896	95231	95236	95240	95245	95250	95255	95260	95265	95270	95274
897	95279	95284	95289	95294	95299	95303	95308	95313	95318	95323
898	95328	95332	95337	95342	95347	95352	95357	95361	95366	95371
899	95376	95381	95386	95390	95395	95400	95405	95410	95415	95419
900	2.95424	2.95429	2.95434	2.95439	2.95443	2.95448	2.95453	2.95458	2.95463	2.95468
901	95472	95477	95482	95487	95492	95497	95501	95506	95511	95516
902	95521	95525	95530	95535	95540	95545	95549	95554	95559	95564
903	95569	95574	95578	95583	95588	95593	95598	95602	95607	95612
904	95617	95622	95626	95631	95636	95641	95646	95650	95655	95660
905	95665	95670	95674	95679	95684	95689	95694	95698	95703	95708
906	95713	95718	95722	95727	95732	95737	95742	95746	95751	95756
907	95761	95765	95771	95775	95780	95785	95789	95794	95799	95804
908	95809	95813	95818	95823	95828	95832	95837	95842	95847	95852
909	95856	95861	95866	95871	95875	95880	95885	95890	95895	95899
910	2.95904	2.95909	2.95914	2.95918	2.95923	2.95928	2.95933	2.95937	2.95942	2.95947
911	95952	95957	95961	95966	95971	95976	95980	95985	95990	95995
912	95999	96004	96009	96014	96018	96023	96028	96033	96038	96042
913	96047	96052	96057	96061	96066	96071	96076	96080	96085	96090
914	96095	96099	96104	96109	96114	96118	96123	96128	96133	96137
915	96142	96147	96152	96156	96161	96165	96171	96175	96180	96185
916	96189	96194	96199	96204	96208	96213	96218	96223	96227	96232
917	96237	96242	96246	96251	96256	96261	96265	96270	96275	96279
918	96284	96289	96293	96298	96303	96307	96313	96317	96322	96327
919	96331	96336	96341	96346	96350	96355	96360	96365	96369	96374
920	2.96379	2.96383	2.96388	2.96393	2.96398	2.96402	2.96407	2.96412	2.96416	2.96421
921	96426	96431	96435	96440	96445	96449	96454	96459	96464	96468
922	96473	96478	96482	96487	96492	96497	96501	96506	96511	96515
923	96520	96525	96530	96534	96539	96544	96548	96553	96558	96562
924	96567	96572	96577	96581	96586	96591	96595	96600	96605	96609
925	96614	96619	96624	96628	96633	96638	96642	96647	96651	96656
926	96661	96666	96670	96675	96680	96684	96689	96694	96699	96703
927	96708	96713	96717	96722	96727	96731	96736	96741	96745	96750
928	96755	96759	96764	96769	96773	96778	96783	96787	96792	96797
929	96802	96806	96811	96816	96820	96825	96830	96834	96839	96844
930	2.96848	2.96853	2.96858	2.96862	2.96867	2.96872	2.96876	96881	2.96886	2.96890
931	96895	96900	96904	96909	96914	96918	96923	96928	96932	96937
932	96942	96946	96951	96956	96960	96965	96969	96974	96979	96983
933	96988	96993	96997	97002	97007	97011	97016	97021	97025	97030
934	97035	97039	97044	97049	97053	97058	97062	97067	97072	97076
935	97081	97086	97090	97095	97100	97104	97109	97114	97118	97123
936	97128	97132	97137	97141	97146	97151	97155	97160	97165	97169
937	97174	97179	97183	97188	97192	97197	97202	97206	97211	97216
938	97220	97225	97229	97234	97239	97243	97248	97253	97257	97262
939	97267	97271	97276	97280	97285	97290	97294	97299	97303	97308

A Table of Logarithms from 1 to 10,000.

No.	0	1	2	3	4	5	6	7	8	9
940	2. 97313	2. 97317	2. 97322	2. 97326	2. 97331	2. 97336	2. 97340	2. 97345	2. 97350	2. 97354
941	97359	97364	97368	97373	97377	97382	97387	97391	97396	97400
942	97405	97410	97414	97419	97423	97428	97433	97437	97442	97447
943	97451	97456	97460	97465	97470	97474	97479	97483	97488	97492
944	97497	97502	97506	97511	97516	97520	97525	97529	97534	97539
945	97543	97548	97552	97557	97562	97566	97571	97575	97580	97584
946	97589	97594	97598	97603	97607	97612	97617	97621	97626	97630
947	97635	97640	97644	97649	97653	97658	97662	97667	97672	97676
948	97681	97685	97690	97694	97699	97704	97708	97713	97717	97722
949	97727	97731	97736	97740	97745	97749	97754	97759	97763	97768
950	2. 97772	2. 97777	2. 97781	2. 97786	2. 97791	2. 97795	2. 97800	2. 97804	2. 97809	2. 97813
951	97818	97823	97827	97832	97836	97841	97845	97850	97855	97859
952	97864	97868	97873	97877	97882	97886	97891	97896	97900	97905
953	97909	97914	97918	97923	97927	97932	97937	97941	97946	97950
954	97955	97959	97964	97968	97973	97978	97982	97987	97991	97996
955	98000	98005	98009	98014	98018	98023	98028	98032	98037	98042
956	98046	98050	98055	98059	98064	98068	98073	98078	98082	98087
957	98091	98096	98100	98105	98109	98114	98118	98123	98127	98132
958	98136	98141	98146	98150	98155	98159	98164	98168	98173	98177
959	98182	98186	98191	98195	98200	98204	98209	98213	98218	98223
960	2. 98227	2. 98232	2. 98236	2. 98241	2. 98245	2. 98250	2. 98254	2. 98259	2. 98263	2. 98268
961	98272	98277	98281	98286	98290	98295	98299	98304	98308	98313
962	98317	98322	98326	98331	98336	98340	98345	98349	98354	98358
963	98363	98367	98372	98376	98381	98385	98389	98394	98399	98403
964	98408	98412	98417	98421	98426	98430	98435	98439	98444	98448
965	98453	98457	98462	98466	98471	98475	98480	98484	98489	98493
966	98498	98502	98507	98511	98516	98520	98525	98529	98534	98538
967	98543	98547	98552	98556	98561	98565	98570	98574	98579	98583
968	98587	98592	98596	98601	98605	98610	98614	98619	98622	98628
969	98632	98637	98641	98646	98650	98655	98659	98664	98668	98673
970	2. 98677	2. 98682	2. 98686	2. 98691	2. 98695	2. 98699	2. 98704	2. 98708	2. 98713	2. 98717
971	98722	98726	98731	98735	98740	98744	98749	98753	98758	98762
972	98767	98771	98776	98780	98784	98789	98793	98798	98802	98807
973	98811	98816	98820	98825	98829	98834	98838	98842	98847	98851
974	98856	98860	98865	98869	98874	98878	98883	98887	98891	98896
975	98900	98905	98909	98914	98918	98923	98927	98932	98936	98940
976	98945	98949	98954	98958	98963	98967	98972	98976	98981	98985
977	98989	98994	98998	99003	99007	99012	99016	99021	99025	99029
978	99034	99038	99043	99047	99052	99056	99060	99065	99069	99074
979	99078	99083	99087	99092	99096	99100	99105	99109	99114	99118
980	2. 99123	2. 99127	2. 99131	2. 99136	2. 99140	2. 99145	2. 99149	2. 99154	2. 99158	2. 99162
981	99167	99171	99176	99180	99185	99189	99193	99198	99202	99207
982	99211	99216	99220	99224	99229	99233	99238	99242	99246	99251
983	99255	99259	99264	99269	99273	99277	99282	99286	99291	99295
984	99299	99304	99308	99313	99317	99322	99326	99330	99335	99339
985	99344	99348	99352	99357	99361	99366	99370	99374	99379	99383
986	99388	99392	99396	99401	99405	99410	99414	99418	99423	99427
987	99437	99436	99440	99445	99449	99454	99458	99462	99467	99471
988	99476	99480	99484	99489	99493	99498	99502	99506	99511	99515
989	99520	99524	99528	99533	99537	99542	99546	99550	99555	99559
990	2. 99563	2. 99568	2. 99572	2. 99577	2. 99581	2. 99585	2. 99590	2. 99594	2. 99599	2. 99603
991	99607	99612	99616	99620	99625	99629	99634	99638	99642	99647
992	99651	99655	99660	99664	99669	99673	99677	99682	99686	99690
993	99695	99699	99704	99708	99712	99717	99721	99725	99730	99734
994	99739	99743	99747	99752	99756	99760	99765	99769	99774	99778
995	99782	99787	99791	99795	99800	99804	99808	99813	99817	99822
996	99826	99830	99835	99839	99843	99848	99852	99856	99861	99865
997	99869	99874	99878	99883	99887	99891	99896	99900	99904	99909
998	99913	99917	99922	99926	99930	99935	99939	99943	99948	99952
999	99956	99961	99965	99971	99974	99978	99983	99987	99991	99996

A Table of Artificial Sines, Tang. and Sec. o Degrees.

M.	Sine.	Co-sine.	Tang.	Co-tang.	Secant.	Co-secant.	
0	0.00000	10.00000	0.00000	Infinite.	10.00000	Infinite.	60
1	5.46372	.00000	6.46373	13.53027	10.00000	13.53627	59
2	76476	00000	76476	23524	00000	23524	58
3	94085	00000	94085	05915	00000	05915	57
4	7.06579	00000	7.06579	12.93421	00000	12.93421	56
5	16270	00000	16270	25730	00000	83730	55
6	24183	00000	24183	75512	00000	75512	54
7	30882	00000	30882	69117	00000	69117	53
8	36682	00000	36682	63318	00000	63318	52
9	41797	00000	41797	58203	00000	58203	51
10	46373	00000	46373	53627	00000	53627	50
11	7.50512	10.00000	7.50512	12.49488	10.00000	12.49488	49
12	54291	00000	54291	45709	00000	45709	48
13	57767	00000	57767	42233	00000	42233	47
14	60985	00000	60986	39014	00000	39015	46
15	63982	00000	63982	36018	00000	36018	45
16	66784	00000	66785	33215	00000	33216	44
17	69417	9.99999	69418	30582	00000	30583	43
18	71900	99999	71900	28100	00001	28100	42
19	74248	99999	74248	25752	00001	25752	41
20	76475	99999	76476	23524	00001	23525	40
21	2.78594	9.99999	7.78595	12.21405	10.00001	12.21405	39
22	80615	99999	80615	19385	00001	19385	38
23	82545	99999	82546	17454	00001	17455	37
24	84393	99999	84394	15605	00001	15607	36
25	86166	99999	86167	13833	00001	13834	35
26	87869	99999	87871	12129	00001	12130	34
27	89503	99999	89510	10490	00001	10491	33
28	91088	99999	91089	08911	00001	08912	32
29	92612	99999	92613	07387	00002	07388	31
30	94084	99999	94086	05924	00002	05926	30
31	7.95508	9.99998	7.95510	12.04490	10.00002	12.04492	29
32	96887	99998	96889	03111	00002	03113	28
33	98223	99998	98225	01775	00002	01777	27
34	99520	99998	99522	00478	00002	00480	26
35	8.00779	99998	8.00781	11.99219	00002	11.99221	25
36	02002	99998	02004	97996	00002	97998	24
37	03192	99997	03194	96805	00003	96808	23
38	04350	99997	04353	95647	00003	95650	22
39	05478	99997	05481	94519	00003	94522	21
40	06578	99997	06581	93419	00003	93422	20
41	8.07650	9.99997	8.07653	11.92547	10.00003	11.92550	19
42	08696	99997	08700	91300	00003	91304	18
43	09718	99997	09722	90278	00003	90282	17
44	10717	99996	10720	89280	00004	89283	16
45	11693	99996	11696	88304	00004	88307	15
46	12647	99996	12650	87349	00004	87353	14
47	13581	99996	13585	86415	00004	86419	13
48	14495	99996	14500	85500	00004	85505	12
49	15391	99996	15395	84605	00004	84609	11
50	16268	99995	16273	83727	00005	83732	10
51	8.17128	9.99995	8.17133	11.82867	10.00005	11.82872	9
52	17971	99995	17976	82024	00005	82029	8
53	18798	99995	18804	81196	00005	81202	7
54	19610	99995	19616	80384	00005	80390	6
55	20407	99994	20413	79587	00006	79593	5
56	21189	99994	21195	78805	00006	78811	4
57	21958	99994	21964	78036	00006	78042	3
58	22713	99994	22719	77280	00006	77286	2
59	23456	99994	23462	76538	00006	76544	1
60	24185	99993	24192	75808	00006	75814	0
	Co-sine.	Sine.	Co-tan.	Tangent.	Co-secant.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 1 Degree.

M.	Sine.	Co-sine.	Tang.	Co-tang.	Secant.	Co-secant.	
0	8.24185	9.99993	8.24192	11.75808	10.00007	11.75814	60
1	24903	99993	24910	75900	00007	75997	59
2	25609	99993	25616	74383	00007	74391	58
3	26304	99993	26311	73688	00007	73696	57
4	26988	99992	26996	73004	00007	73012	56
5	27661	99992	27669	72331	00008	72339	55
6	28324	99992	28332	71668	00008	71676	54
7	28977	99992	28986	71014	00008	71023	53
8	29621	99991	29629	70371	00008	70379	52
9	30255	99991	30263	69737	00009	69745	51
10	8.30879	9.99991	8.30888	11.69112	10.00009	11.69121	50
11	31495	99990	31505	68405	00009	68505	49
12	32103	99990	32112	67888	00009	67897	48
13	32702	99990	32711	67289	00010	67298	47
14	33292	99990	33302	66697	00010	66708	46
15	33875	99999	33886	66114	00010	66125	45
16	34450	99999	34461	65539	00011	65550	44
17	35018	99999	35029	64971	00011	64982	43
18	35578	99999	35589	64410	00011	64422	42
19	36131	99998	36143	63857	00011	63868	41
20	8.36678	9.99988	8.36689	11.63310	10.00012	11.63322	40
21	37217	99988	37229	62771	00012	62783	39
22	37750	99988	37762	62238	00012	62250	38
23	38276	99987	38289	61711	00013	61724	37
24	38796	99987	38809	61191	00013	61204	36
25	39310	99987	39323	60677	00013	60690	35
26	39818	99986	39831	60168	00014	60182	34
27	40320	99986	40334	59666	00014	59680	33
28	40816	99986	40830	59170	00014	59184	32
29	41307	99985	41321	58679	00015	58693	31
30	8.41792	9.99985	8.41807	11.58193	10.00015	11.58208	30
31	42272	99985	42287	57713	00015	57728	29
32	42746	99984	42762	57238	00016	57254	28
33	43216	99984	43231	56768	00016	56784	27
34	43680	99984	43696	56304	00016	56320	26
35	44139	99983	44156	55844	00017	55861	25
36	44594	99983	44611	55389	00017	55406	24
37	45044	99983	45061	54939	00017	54956	23
38	45489	99982	45507	54493	00018	54510	22
39	45930	99982	45948	54052	00018	54070	21
40	8.46366	9.99982	8.46385	11.53615	10.00018	11.53633	20
41	46798	99981	46817	53183	00019	53201	19
42	47226	99981	47245	52755	00019	52774	18
43	47650	99980	47669	52331	00019	52350	17
44	48069	99980	48089	51911	00020	51931	16
45	48485	99980	48505	51495	00020	51515	15
46	48896	99979	48917	51083	00021	51104	14
47	49304	99979	49325	50675	00021	50696	13
48	49708	99979	49729	50271	00021	50292	12
49	50108	99978	50130	49870	00022	49892	11
50	8.50504	9.99978	8.50527	11.49473	10.00022	11.49495	10
51	50897	99977	50920	49080	00023	49103	9
52	51287	99977	51310	48690	00023	48713	8
53	51673	99976	51696	48304	00023	48328	7
54	52055	99976	52079	47921	00024	47945	6
55	52434	99976	52459	47541	00024	47566	5
56	52810	99975	52835	47165	00025	47190	4
57	53183	99975	53208	46792	00025	46817	3
58	53552	99974	53578	46422	00026	46448	2
59	53919	99974	53945	46055	00026	46081	1
60	54282	99973	54308	45692	00026	45718	0
	Co fine.	Sine.	Co-tang.	Tangent.	Co-secan.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 2 Degrees.

M.	Sine.	Co-sine.	Tang.	Co-tang.	Secant.	Co-secant.	
0	8. 54282	9. 99973	8. 54309	11. 45692	10. 00026	11. 45718	60
1	54642	99973	54669	45331	00027	45358	59
2	54999	99973	55027	44973	00027	45000	58
3	55354	99972	55382	44618	00028	44646	57
4	55705	99972	55734	44266	00028	44295	56
5	56054	99971	56083	43917	00029	43946	55
6	56400	99971	56429	43571	00029	43600	54
7	56743	99970	56773	43227	00030	43257	53
8	57084	99970	57114	42886	00030	42916	52
9	57421	99970	57452	42548	00030	42579	51
10	8. 57757	9. 99969	8. 57788	11. 42212	10. 00031	11. 42243	50
11	58089	99968	58121	41879	00031	41911	49
12	58419	99968	58451	41549	00032	41581	48
13	58747	99967	58779	41221	00032	41253	47
14	59072	99967	59105	40895	00033	40927	46
15	59395	99966	59428	40572	00033	40605	45
16	59715	99966	59749	40251	00034	40285	44
17	60033	99965	60068	39932	00034	39967	43
18	60349	99965	60384	39616	00035	39651	42
19	60662	99964	60698	39302	00035	39338	41
20	8. 60973	9. 99964	8. 61009	11. 38991	10. 00036	11. 39027	40
21	61282	99963	61319	38681	00036	38718	39
22	61589	99963	61626	38374	00037	38411	38
23	61894	99962	61931	38069	00038	38106	37
24	62196	99962	62234	37766	00038	37804	36
25	62496	99961	62535	37465	00039	37503	35
26	62795	99961	62834	37166	00039	37205	34
27	63091	99960	63131	36869	00040	36909	33
28	63385	99960	63426	36574	00040	36615	32
29	63678	99959	63718	36281	00040	36322	31
30	8. 63968	9. 99959	8. 64009	11. 35991	10. 00041	11. 36032	30
31	64256	99958	64298	35702	00042	35744	29
32	64543	99957	64585	35415	00042	35457	28
33	64827	99957	64870	35130	00043	35173	27
34	65110	99956	65154	34846	00044	34890	26
35	65391	99956	65435	34565	00044	34609	25
36	65670	99955	65715	34285	00045	34330	24
37	65947	99955	65993	34007	00045	34052	23
38	66223	99954	66269	33731	00046	33777	22
39	66497	99953	66543	33457	00046	33503	21
40	8. 66769	9. 99953	8. 66816	11. 33184	10. 00047	11. 33231	20
41	67039	99952	67087	32913	00048	32961	19
42	67308	99952	67356	32644	00048	32692	18
43	67575	99951	67624	32376	00049	32425	17
44	67840	99951	67890	32110	00049	32160	16
45	68104	99950	68154	31846	00050	31896	15
46	68366	99949	68417	31583	00051	31633	14
47	68627	99949	68678	31322	00051	31373	13
48	68886	99948	68938	31062	00052	31114	12
49	69144	99947	69169	30804	00052	30856	11
50	8. 69400	9. 99947	8. 69453	11. 30547	10. 00053	11. 30600	10
51	69654	99946	69708	30292	00054	30346	9
52	69907	99946	69962	30038	00054	30093	8
53	70159	99945	70214	29786	00055	29841	7
54	70409	99944	70465	29535	00056	29591	6
55	70658	99944	70714	29286	00056	29342	5
56	70905	99943	70962	29038	00057	29095	4
57	71151	99942	71208	28792	00058	28849	3
58	71395	99942	71453	28546	00058	28605	2
59	71638	99941	71697	28303	00059	28361	1
60	71880	99940	71940	28060	00060	28120	0
	Co sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 3 Degree.

M.	Sine.	Co-sine.	Tang.	Co-tang.	Secant.	Co-secant.	
0	8.71880	9.99940	8.71940	11.23060	10.00059	11.28120	60
1	72120	99940	72181	27819	00060	27880	59
2	72359	99939	72420	27580	00061	27640	58
3	72597	99938	72659	27341	00062	27403	57
4	72834	99938	72896	27104	00062	27166	56
5	73069	99937	73132	26868	00063	26931	55
6	73303	99936	73366	26634	00064	26697	54
7	73535	99936	73600	26400	00064	26465	53
8	73767	99935	73832	26168	00065	26233	52
9	73997	99934	74063	25937	00065	26003	51
10	8.74226	9.99934	8.74292	11.25708	10.00066	11.25774	50
11	74454	99933	74521	25479	00067	25546	49
12	74680	99932	74748	25252	00068	25320	48
13	74905	99931	74974	25026	00068	25094	47
14	75130	99931	75199	24801	00069	24870	46
15	75353	99930	75423	24577	00070	24647	45
16	75575	99929	75645	24355	00071	24425	44
17	75795	99929	75867	24133	00071	24204	43
18	76015	99928	76087	23913	00072	23985	42
19	76234	99927	76306	23693	00073	23766	41
20	8.76451	9.99926	8.76525	11.23475	10.00073	11.23549	40
21	76667	99926	76742	23258	00074	23332	39
22	76883	99925	76958	23042	00075	23117	38
23	77097	99924	77173	22827	00076	22993	37
24	77310	99923	77387	22613	00076	22690	36
25	77522	99923	77599	22400	00077	22478	35
26	77733	99922	77811	22189	00078	22267	34
27	77943	99921	78022	21978	00079	22057	33
28	78152	99920	78253	22768	00079	21848	32
29	78360	99920	78441	21559	00080	21639	31
30	8.78567	9.99919	8.78649	11.21351	10.00081	11.21432	30
31	78774	99918	78855	21145	00082	21226	29
32	78979	99917	79061	20939	00083	21021	28
33	79183	99917	79266	20734	00083	20817	27
34	79386	99916	79470	20530	00084	20614	26
35	79588	99915	79673	20327	00085	20412	25
36	79789	99914	79875	20123	00086	20211	24
37	79990	99913	80076	19924	00087	20010	23
38	80189	99913	80276	19723	00087	19811	22
39	80388	99912	80476	19524	00088	19612	21
40	8.80585	9.99911	8.80674	11.19326	10.00099	11.19415	20
41	80782	99910	80872	19128	00090	19218	19
42	80978	99909	81068	18932	00091	19022	18
43	81173	99909	81264	18736	00091	18827	17
44	81367	99908	81459	18541	00092	18633	16
45	81560	99907	81653	18347	00093	18440	15
46	81752	99906	81846	18154	00094	18248	14
47	81944	99905	82038	17962	00095	18056	13
48	82134	99904	82230	17770	00096	17866	12
49	82324	99904	82424	17579	00097	17676	11
50	8.82513	9.99903	8.82610	11.17390	10.00097	11.17487	10
51	82701	99902	82799	17201	00098	17299	9
52	82888	99901	82987	17013	00099	17112	8
53	83075	99900	83175	16825	00100	16925	7
54	83261	99899	83361	16639	00101	16739	6
55	83446	99898	83547	16453	00102	16554	5
56	83630	99898	83732	16268	00102	16370	4
57	83813	99897	83916	16084	00103	16187	3
58	83996	99896	84100	15900	00104	16004	2
59	84177	99895	84282	15717	00105	15823	1
60	84358	99894	84464	15536	00106	15642	0
	Co fine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 4 Degrees.

M.	S.ne.	Co-line.	Tang.	Co-tang.	Secant.	Co-secant.	
0	8. 84338	9. 99894	8. 84464	11. 15556	10. 00106	11. 15642	60
1	84539	99893	84645	15355	00107	15461	59
2	84718	99892	84826	15175	00108	15282	58
3	84897	99891	85006	14995	00109	15103	57
4	85075	99890	85185	14814	00109	14925	56
5	85252	99890	85363	14637	00110	14748	55
6	85429	99889	85540	14460	00111	14571	54
7	85605	99888	85717	14283	00112	14395	53
8	85780	99887	85893	14107	00113	14220	52
9	85955	99886	86069	13931	00114	14045	51
10	8. 86128	9. 99885	8. 86243	11. 13757	10. 00115	11. 13872	50
11	86301	99884	86417	13583	00116	13699	49
12	86474	99883	86590	13409	00117	13526	48
13	86645	99882	86763	13237	00118	13355	47
14	86816	99881	86935	13065	00119	13183	46
15	86987	99880	87106	12894	00120	13013	45
16	87156	99879	87277	12723	00120	12843	44
17	87325	99878	87447	12553	00121	12674	43
18	87494	99878	87616	12384	00122	12506	42
19	87661	99877	87785	12215	00123	12338	41
20	8. 87828	9. 99876	8. 87953	11. 12047	10. 00124	11. 12171	40
21	87995	99875	88120	11880	00125	12005	39
22	88161	99874	88287	11713	00126	11839	38
23	88326	99873	88433	11547	00127	11674	37
24	88490	99872	88618	11381	00128	11510	36
25	88654	99871	88785	11217	00129	11346	35
26	88817	99870	88948	11052	00130	11183	34
27	88980	99869	89111	10889	00131	11020	33
28	89142	99868	89274	10726	00132	10858	32
29	89303	99867	89437	10563	00133	10696	31
30	8. 89464	9. 99866	8. 89598	11. 10402	10. 00134	11. 10536	30
31	89624	99865	89760	10240	00135	10375	29
32	89784	99864	89920	10080	00136	10216	28
33	89943	99863	90080	9920	00137	10057	27
34	90102	99862	90240	9760	00138	9898	26
35	90260	99861	90399	9601	00139	9740	25
36	90417	99860	90557	9443	00140	9583	24
37	90574	99859	90715	9285	00141	9426	23
38	90730	99858	90872	9128	00142	9270	22
39	90885	99857	91028	8971	00143	9115	21
40	8. 91040	9. 99856	8. 91185	11. 08815	10. 00144	11. 08960	20
41	91195	99855	91340	8860	00145	8805	19
42	91349	99854	91495	8705	00146	8651	18
43	91502	99853	91649	8550	00147	8498	17
44	91655	99852	91803	8397	00148	8345	16
45	91807	99851	91957	8243	00149	8193	15
46	91959	99849	92110	8090	00150	8041	14
47	92110	99848	92262	7938	00151	7890	13
48	92261	99847	92514	7786	00153	7739	12
49	92411	99846	92565	7635	00154	7589	11
50	8. 92561	9. 99845	8. 92716	11. 07284	10. 00155	11. 07439	10
51	92710	99844	92866	7534	00156	7490	9
52	92859	99843	93015	7384	00157	7341	8
53	93007	99842	93165	7235	00158	7193	7
54	93154	99841	93313	7087	00159	7046	6
55	93301	99840	93462	6938	00160	6898	5
56	93448	99839	93609	6791	00161	6752	4
57	93594	99838	93756	6643	00162	6606	3
58	93740	99837	93903	6497	00163	6460	2
59	93885	99835	94049	6351	00164	6315	1
60	94030	99834	94195	6205	00166	6170	0
	Co-line.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 5 Degrees.

M.	Sine.	Co-sine.	Tang.	Co-tang.	Secant.	Co-secant.	
0	8.94030	9.99834	8.94195	11.05805	10.00166	11.05670	60
1	94174	99833	94340	05660	00167	05826	59
2	94317	99832	94485	05515	00168	05683	58
3	94461	99831	94629	05370	00169	05539	57
4	94603	99830	94773	05227	00170	05397	56
5	94746	99829	94917	05083	00171	05254	55
6	94887	99828	95060	04940	00172	05113	54
7	95029	99827	95202	04798	00173	04972	53
8	95170	99825	95344	04656	00174	04830	52
9	95310	99824	95486	04514	00176	04690	51
10	8.95450	9.99823	8.95627	11.04373	10.00177	11.04550	50
11	95590	99822	95767	04233	00178	04410	49
12	95728	99821	95907	04092	00179	04272	48
13	95867	99820	96047	03953	00180	04133	47
14	96005	99819	96187	03813	00181	03995	46
15	96143	99817	96325	03674	00183	03857	45
16	96280	99816	96464	03536	00184	03720	44
17	96417	99815	96602	03398	00185	03583	43
18	96553	99814	96739	03261	00186	03447	42
19	96689	99813	96877	03123	00187	03311	41
20	8.96825	9.99812	8.97013	11.02987	10.00188	11.03175	40
21	96960	99810	97150	02850	00190	03040	39
22	97095	99809	97285	02714	00191	02905	38
23	97229	99808	97421	02579	00192	02771	37
24	97363	99807	97556	02444	00193	02637	36
25	97496	99806	97691	02309	00194	02504	35
26	97629	99804	97825	02175	00196	02370	34
27	97762	99803	97959	02041	00197	02238	33
28	97894	99802	98092	01908	00198	02106	32
29	98026	99801	98225	01775	00199	01974	31
30	8.98157	9.99800	8.98358	11.01642	10.00200	11.01843	30
31	98288	99798	98490	01510	00202	01712	29
32	98419	99797	98622	01378	00203	01581	28
33	98549	99796	98753	01247	00204	01450	27
34	98679	99795	98884	01116	00205	01321	26
35	98808	99793	99015	00985	00206	01192	25
36	98937	99792	99145	00855	00208	01063	24
37	99066	99791	99275	00725	00209	00934	23
38	99194	99790	99404	00595	00210	00806	22
39	99322	99788	99534	00466	00211	00678	21
40	8.99450	9.99787	8.99662	11.00338	10.00213	11.00550	20
41	99577	99786	99791	00209	00214	00423	19
42	99704	99785	99919	00081	00215	00296	18
43	99830	99783	9.00046	10.99953	00216	00170	17
44	99956	99782	00174	99826	00218	00044	16
45	9.00082	99781	00301	99699	00219	10.99918	15
46	00207	99780	00427	99573	00220	99793	14
47	00332	99777	00553	99447	00222	99668	13
48	00456	99777	00679	99321	00223	99544	12
49	00580	99776	00805	99195	00224	99419	11
50	9.00704	9.99774	9.00930	10.99070	10.00225	10.99296	10
51	00828	99773	01055	98945	00227	99172	9
52	00951	99772	01179	98821	00228	99049	8
53	01074	99771	01303	98697	00229	98926	7
54	01196	99769	01427	98573	00231	98804	6
55	01318	99768	01550	98450	00232	98682	5
56	01440	99767	01673	98327	00233	98560	4
57	01561	99765	01796	98204	00234	98439	3
58	01682	99764	01918	98082	00236	98318	2
59	01803	99763	02040	97960	00237	98197	1
60	01923	99761	02162	97838	00239	98076	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 6 Degrees.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secants.	Co-secant.	
0	9.01923	9.99761	9.02162	10.97838	10.00239	10.98076	60
1	02043	99760	02283	97717	00240	97956	59
2	02163	99759	02404	97596	00251	97837	58
3	02282	99757	02525	97475	00243	97717	57
4	02402	99756	02645	97354	00244	97598	56
5	02520	99755	02765	97234	00245	97480	55
6	02639	99753	02885	97115	00247	97361	54
7	02757	99752	03005	96995	00248	97244	53
8	02874	99751	03124	96876	00249	97126	52
9	02992	99749	03242	96757	00250	97008	51
10	9.03109	9.99748	9.03361	10.96639	10.00252	10.96891	50
11	03226	99747	03479	96521	00253	96774	49
12	03342	99745	03597	96403	00255	96658	48
13	03458	99744	03714	96286	00256	96542	47
14	03574	99742	03832	96168	00257	96426	46
15	03690	99741	03948	96051	00259	96310	45
16	03805	99740	04065	95935	00260	96195	44
17	03920	99738	04181	95819	00262	96080	43
18	04034	99737	04297	95703	00263	95966	42
19	04148	99735	04413	95587	00264	95851	41
20	9.04262	9.99734	9.04528	10.95472	10.00266	10.95737	40
21	04376	99733	04643	95357	00267	95624	39
22	04489	99731	04758	95242	00269	95510	38
23	04603	99730	04873	95127	00270	95397	37
24	04715	99728	04987	95013	00271	95285	36
25	04828	99727	05101	94899	00273	95172	35
26	04940	99726	05214	94786	00274	95060	34
27	05052	99724	05328	94672	00276	94948	33
28	05163	99723	05441	94559	00277	94836	32
29	05275	99721	05553	94447	00279	94725	31
30	9.05386	9.99720	9.05666	10.94334	10.00280	10.94614	30
31	05497	99718	05778	94222	00281	94503	29
32	05607	99717	05890	94110	00283	94393	28
33	05717	99716	06002	93998	00284	94283	27
34	05827	99714	06113	93887	00286	94173	26
35	05937	99713	06224	93776	00287	94063	25
36	06046	99711	06335	93665	00289	93954	24
37	06155	99710	06445	93555	00290	93845	23
38	06264	99708	06556	93444	00292	93736	22
39	06372	99707	06665	93334	00293	93628	21
40	9.06481	9.99705	9.06775	10.93225	10.00295	10.93519	20
41	06588	99704	06885	93115	00296	93411	19
42	06696	99702	06994	93006	00298	93304	18
43	06804	99701	07103	92897	00299	93196	17
44	06911	99699	07211	92789	00301	93089	16
45	07018	99698	07320	92680	00302	92982	15
46	07124	99696	07428	92572	00304	92876	14
47	07230	99695	07536	92464	00305	92769	13
48	07337	99693	07643	92357	00307	92663	12
49	07442	99692	07750	92249	00308	92558	11
50	9.07548	9.99690	9.07858	10.92142	10.00310	10.92452	10
51	07653	99689	07964	92036	00311	92347	9
52	07758	99687	08071	91929	00313	92242	8
53	07863	99686	08177	91823	00314	92137	7
54	07968	99684	08283	91717	00316	92032	6
55	08072	99683	08389	91611	00317	91928	5
56	08176	99681	08495	91505	00319	91824	4
57	08280	99680	08601	91400	00320	91720	3
58	08383	99678	08705	91295	00322	91617	2
59	08486	99677	08810	91190	00323	91514	1
60	08589	99675	08914	91086	00325	91411	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 7 Degrees.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9. 08589	9. 99675	9. 08914	10. 91086	10. 00325	10. 91411	60
1	08692	99673	09019	90981	00326	91308	59
2	08795	99672	09123	90877	00328	91205	58
3	08897	99670	09227	90773	00330	91103	57
4	08999	99669	09339	90670	00331	91001	56
5	09101	99667	09433	90566	00333	90899	55
6	09202	99666	09537	90463	00334	90798	54
7	09304	99664	09640	90360	00336	90696	53
8	09405	99662	09742	90258	00337	90595	52
9	09506	99661	09845	90155	00339	90494	51
10	9. 09606	9. 99659	9. 09947	10. 90053	10. 00341	10. 90394	50
11	09706	99658	10049	89951	00342	90293	49
12	09807	99656	10150	89849	00344	90193	48
13	09906	99655	10252	89748	00345	90094	47
14	10006	99653	10353	89647	00347	89994	46
15	10106	99651	10454	89546	00349	89894	45
16	10205	99650	10555	89445	00350	89795	44
17	10304	99648	10656	89344	00352	89696	43
18	10402	99646	10756	89244	00353	89597	42
19	10501	99645	10856	89144	00355	89499	41
20	9. 10599	9. 99643	9. 10956	10. 89044	10. 00357	10. 89401	40
21	10697	99642	11056	88944	00358	89303	39
22	10795	99640	11155	88845	00360	89205	38
23	10893	99638	11254	88746	00362	89107	37
24	10990	99637	11353	88647	00363	89010	36
25	11087	99635	11452	88548	00365	88913	35
26	11184	99633	11551	88449	00366	88816	34
27	11281	99632	11649	88351	00368	88719	33
28	11377	99630	11747	88253	00370	88623	32
29	11474	99628	11845	88155	00371	88526	31
30	9. 11570	9. 99627	9. 11943	10. 88057	10. 00373	10. 88430	30
31	11666	99625	12040	87960	00375	88334	29
32	11761	99623	12138	87862	00376	88239	28
33	11857	99622	12235	87765	00378	88143	27
34	11952	99620	12332	87668	00380	88048	26
35	12047	99618	12428	87572	00381	87953	25
36	12142	99617	12525	87475	00383	87858	24
37	12236	99615	12621	87379	00385	87764	23
38	12331	99613	12717	87283	00387	87669	22
39	12425	99612	12813	87187	00388	87575	21
40	9. 12516	9. 99610	9. 12909	10. 87091	10. 00390	10. 87481	20
41	12612	99608	13004	86996	00392	87387	19
42	12706	99607	13099	86901	00393	87294	18
43	12799	99605	13194	86806	00395	87201	17
44	12892	99603	13289	86711	00397	87107	16
45	12985	99601	13384	86616	00398	87015	15
46	13078	99600	13478	86522	00400	86922	14
47	13171	99598	13573	86427	00402	86829	13
48	13263	99596	13667	86333	00404	86737	12
49	13355	99595	13760	86239	00405	86645	11
50	9. 13447	9. 99593	9. 13854	10. 86146	10. 00407	10. 86553	10
51	13539	99591	13948	86052	00409	86461	9
52	13630	99589	14041	85959	00411	86370	8
53	13722	99588	14134	85866	00412	86278	7
54	13813	99586	14227	85773	00414	86187	6
55	13904	99584	14320	85680	00416	86096	5
56	13994	99582	14412	85588	00418	86006	4
57	14085	99581	14504	85496	00419	85915	3
58	14175	99579	14596	85403	00421	85825	2
59	14265	99577	14688	85311	00423	85734	1
60	14355	99575	14780	85220	00425	85645	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co secant.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 8 Degrees.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9. 14355	9. 99575	9. 14780	10. 85220	10. 00425	10. 85644	60
1	14445	99573	14872	85128	00426	85555	59
2	14535	99572	14963	85037	00428	85465	58
3	14624	99570	15054	84946	00430	85376	57
4	14714	99568	15145	84855	00432	85286	56
5	14803	99566	15236	84764	00434	85197	55
6	14891	99565	15327	84673	00435	85108	54
7	14980	99563	15417	84583	00437	85020	53
8	15069	99561	15508	84492	00439	84931	52
9	15157	99559	15598	84402	00441	84843	51
10	9. 15245	9. 99557	9. 15688	10. 84312	10. 00443	10. 84755	50
11	15333	99555	15777	84222	00444	84667	49
12	15421	99554	15867	84133	00446	84579	48
13	15508	99552	15956	84043	00448	84492	47
14	15596	99550	16046	83954	00450	84404	46
15	15683	99548	16135	83865	00452	84317	45
16	15770	99546	16224	83776	00453	84230	44
17	15857	99544	16312	83688	00455	84143	43
18	15943	99543	16401	83599	00457	84056	42
19	16030	99541	16489	83511	00459	83970	41
20	9. 16116	9. 99539	9. 16577	10. 83423	10. 00461	10. 83884	40
21	16202	99537	16665	83335	00463	83797	39
22	16288	99535	16753	83247	00465	83711	38
23	16374	99533	16841	83159	00467	83626	37
24	16460	99532	16928	83072	00468	83540	36
25	16545	99530	17016	82984	00470	83455	35
26	16631	99528	17103	82897	00472	83369	34
27	16716	99526	17189	82810	00474	83284	33
28	16801	99524	17277	82723	00476	83199	32
29	16886	99522	17363	82637	00478	83114	31
30	9. 16970	9. 99520	9. 17450	10. 82550	10. 00480	10. 83030	30
31	17055	99518	17536	82464	00482	82945	29
32	17139	99516	17622	82378	00483	82861	28
33	17223	99515	17708	82292	00485	82777	27
34	17307	99513	17794	82206	00487	82693	26
35	17391	99511	17880	82120	00489	82609	25
36	17474	99509	17965	82034	00491	82526	24
37	17558	99507	18051	81949	00493	82442	23
38	17641	99505	18136	81864	00495	82359	22
39	17724	99503	18221	81779	00497	82276	21
40	9. 17807	9. 99501	9. 18306	10. 81694	10. 00499	10. 82193	20
41	17890	99499	18391	81609	00501	82110	19
42	17973	99497	18475	81525	00503	82027	18
43	18055	99495	18560	81440	00504	81945	17
44	18137	99493	18644	81356	00506	81863	16
45	18220	99492	18728	81272	00508	81780	15
46	18302	99490	18812	81188	00510	81698	14
47	18383	99488	18896	81104	00512	81617	13
48	18465	99486	18979	81021	00514	81535	12
49	18547	99484	19063	80937	00516	81453	11
50	9. 18628	9. 99482	9. 19146	10. 80854	10. 00518	10. 81372	10
51	18709	99480	19229	80771	00520	81291	9
52	18790	99478	19312	80688	00522	81210	8
53	18871	99476	19395	80605	00524	81129	7
54	18952	99474	19478	80522	00526	81048	6
55	19032	99472	19561	80436	00528	80967	5
56	19113	99470	19643	80357	00530	80887	4
57	19193	99468	19725	80275	00532	80807	3
58	19273	99466	19807	80193	00534	80727	2
59	19353	99464	19889	80111	00536	80647	1
60	19433	99462	19971	80029	00538	80567	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 9 Degrees.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co secant.	
0	9. 19433	9. 99462	9. 19971	10. 80029	10. 00538	10. 80567	60
1	19513	99460	20053	79947	00540	80487	59
2	19592	99458	20134	79865	00542	80407	58
3	19672	99456	20216	79784	00544	80328	57
4	19751	99454	20297	79703	00546	80249	56
5	19830	99452	20378	79621	00548	80169	55
6	19909	99450	20459	79541	00550	80091	54
7	19988	99448	20540	79460	00552	80012	53
8	20067	99446	20621	79379	00554	79933	52
9	20145	99444	20701	79299	00556	79855	51
10	9. 20223	9. 99442	9. 20782	10. 79218	10. 00558	10. 79777	50
11	20402	99440	20862	79138	00560	79698	49
12	20380	99438	20942	79058	00562	79620	48
13	20458	99436	21022	78978	00564	79542	47
14	20535	99434	21102	78898	00566	79465	46
15	20613	99432	21181	78818	00568	79387	45
16	20691	99429	21261	78739	00570	79309	44
17	20768	99427	21340	78659	00573	79232	43
18	20845	99425	21420	78580	00575	79155	42
19	20922	99423	21499	78501	00577	79078	41
20	9. 20999	9. 99421	9. 21578	10. 78422	10. 00579	10. 79001	40
21	21076	99419	21657	78343	00581	78924	39
22	21153	99417	21736	78264	00583	78847	38
23	21229	99415	21814	78186	00585	78771	37
24	21305	99413	21893	78107	00587	78694	36
25	21382	99411	21971	78029	00589	78618	35
26	21458	99409	22049	77951	00591	78542	34
27	21534	99407	22127	77873	00593	78466	33
28	21610	99404	22205	77795	00595	78390	32
29	21685	99402	22283	77717	00597	78315	31
30	9. 21761	9. 99400	9. 22361	10. 77639	10. 00599	10. 78239	30
31	21836	99398	22438	77562	00602	78164	29
32	21912	99396	22516	77484	00604	78088	28
33	21987	99394	22593	77407	00606	78013	27
34	22062	99392	22670	77330	00608	77938	26
35	22137	99390	22747	77253	00610	77863	25
36	22211	99387	22824	77176	00612	77788	24
37	22286	99385	22901	77099	00614	77714	23
38	22361	99383	22977	77022	00617	77639	22
39	22435	99381	23054	76946	00619	77565	21
40	9. 22509	9. 99379	9. 23130	10. 76870	10. 00621	10. 77491	20
41	22583	99377	23206	76793	00623	77417	19
42	22657	99375	23283	76717	00625	77343	18
43	22731	99372	23369	76641	00627	77269	17
44	22805	99370	23444	76565	00630	77195	16
45	22878	99368	23510	76490	00632	77122	15
46	22952	99366	23586	76414	00634	77048	14
47	23025	99364	23661	76339	00636	76975	13
48	23098	99362	23737	76263	00638	76902	12
49	23171	99359	23812	76188	00641	76829	11
50	9. 23244	9. 99357	9. 23887	10. 76113	10. 00643	10. 76756	10
51	23317	99355	23962	76038	00645	76683	9
52	23390	99353	24037	75963	00647	76610	8
53	23462	99351	24112	75888	00649	76537	7
54	23535	99348	24186	75813	00652	76465	6
55	23607	99346	24261	75739	00654	76393	5
56	23679	99344	24335	75665	00656	76320	4
57	23751	99342	24410	75590	00658	76248	3
58	23823	99340	24484	75516	00660	76176	2
59	23895	99337	24558	75442	00663	76105	1
60	23967	99335	24632	75368	00665	76033	0
Co-sine.	Sine.	Co tang.	Tangent.	Co-secant.	Secant.	M.	

A Table of Artificial Sines, Tang. and Sec. 10 Degrees.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9. 23967	9. 99335	9. 24632	10. 75368	10. 00665	10. 76033	60
1	24039	99333	24706	75294	00667	75961	59
2	24111	99331	24779	75221	00669	75890	58
3	24180	99328	24853	75147	00672	75819	57
4	24253	99326	24926	75074	00674	75747	56
5	24324	99324	25000	75000	00676	75676	55
6	24395	99322	25073	74927	00678	75605	54
7	24466	99319	25146	74854	00680	75534	53
8	24536	99317	25219	74781	00683	75464	52
9	24607	99315	25292	74708	00685	75393	51
10	9. 24677	9. 99313	9. 25365	10. 74635	10. 00687	10. 75322	50
11	24748	99310	25437	74563	00690	75252	49
12	24818	99308	25510	74490	00692	75182	48
13	24888	99306	25582	74418	00694	75112	47
14	24958	99304	25655	74345	00696	75042	46
15	25028	99301	25727	74273	00699	74972	45
16	25098	99299	25799	74201	00701	74902	44
17	25168	99297	25871	74129	00703	74832	43
18	25237	99294	25943	74057	00706	74762	42
19	25307	99292	26015	73985	00708	74693	41
20	9. 25376	9. 99270	9. 26086	10. 73914	10. 00710	10. 74623	40
21	25445	99287	26158	73842	00712	74553	39
22	25514	99285	26229	73771	00715	74486	38
23	25583	99283	26300	73699	00717	74417	37
24	25652	99281	26372	73628	00719	74348	36
25	25721	99278	26443	73557	00722	74279	35
26	25790	99276	26514	73486	00724	74210	34
27	25858	99274	26585	73415	00726	74142	33
28	25927	99271	26655	73344	00729	74073	32
29	25995	99269	26726	73274	00731	74005	31
30	9. 26063	9. 99267	9. 26797	10. 73203	10. 00733	10. 73937	30
31	26131	99264	26867	73133	00736	73869	29
32	26199	99262	26937	73063	00738	73801	28
33	26267	99260	27008	72992	00741	73733	27
34	26335	99257	27078	72922	00743	73665	26
35	26403	99255	27148	72852	00745	73597	25
36	26470	99252	27218	72782	00747	73530	24
37	26538	99250	27288	72712	00750	73462	23
38	26605	99248	27357	72643	00752	73395	22
39	26672	99245	27427	72573	00755	73328	21
40	9. 26739	9. 99243	9. 27496	10. 72504	10. 00757	10. 73261	20
41	26806	99241	27566	72434	00759	73193	19
42	26873	99238	27635	72365	00762	73127	18
43	26940	99236	27704	72296	00764	73060	17
44	27007	99233	27773	72227	00766	72993	16
45	27073	99231	27842	72158	00769	72926	15
46	27140	99229	27911	72089	00771	72860	14
47	27206	99226	27980	72020	00774	72794	13
48	27273	99224	28049	71951	00776	72727	12
49	27339	99221	28117	71883	00779	72661	11
50	9. 27405	9. 99219	9. 28186	10. 71814	10. 00781	10. 72595	10
51	27471	99217	28254	71746	00783	72529	9
52	27537	99214	28322	71677	00786	72463	8
53	27602	99212	28391	71609	00788	72398	7
54	27668	99209	28459	71541	00791	72332	6
55	27734	99207	28527	71473	00793	72266	5
56	27799	99204	28595	71405	00796	72201	4
57	27864	99202	28662	71337	00798	72136	3
58	27930	99200	28730	71270	00800	72070	2
59	27995	99197	28798	71202	00803	72005	1
60	28060	99195	28865	71135	00805	71940	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 11 Degrees.

M.	Sine.	Co-sine.	Tang.	Co-tang.	Secant.	Co-secant.	
0	9. 28060	9. 99195	9. 28865	10. 71135	10. 00805	10. 71940	60
1	28125	99192	28933	71067	00808	71875	59
2	28190	99190	29000	71000	00810	71810	58
3	28254	99187	29067	70933	00813	71746	57
4	28319	99185	29134	70866	00815	71681	56
5	28384	99182	29201	70799	00818	71616	55
6	28448	99180	29268	70732	00820	71552	54
7	28512	99177	29335	70665	00823	71488	53
8	28577	99175	29402	70598	00825	71423	52
9	28641	99172	29468	70532	00828	71359	51
10	9. 28705	9. 99170	9. 29535	10. 70465	10. 00830	10. 71295	50
11	28769	99167	29601	70399	00833	71231	49
12	28833	99165	29668	70332	00835	71167	48
13	28896	99162	29734	70266	00838	71104	47
14	28960	99160	29800	70200	00840	71040	46
15	29024	99157	29866	70134	00843	70975	45
16	29087	99155	29932	70068	00848	70913	44
17	29150	99152	29998	70002	00844	70850	43
18	29214	99150	30064	69936	00850	70786	42
19	29277	99147	30129	69870	00853	70723	41
20	9. 29340	9. 99145	9. 30195	10. 69805	10. 00855	11. 70606	40
21	29403	99142	30261	69739	00858	70597	39
22	29466	99140	30326	69674	00860	70534	38
23	29529	99137	30391	69609	00865	70471	37
24	29591	99135	30457	69543	00865	70409	36
25	29654	99132	30522	69478	00868	70346	35
26	29716	99129	30587	69413	00870	70284	34
27	29779	99127	30652	69348	00873	70221	33
28	29841	99124	30717	69283	00876	70159	32
29	29903	99122	30781	69218	00878	70097	31
30	9. 29965	9. 99119	9. 30846	10. 69154	10. 00881	10. 70034	30
31	30028	99117	30911	69089	00883	69972	29
32	30089	99114	30975	69025	00886	69910	28
33	30151	99111	31040	68960	00888	69849	27
34	30213	99109	31104	68896	00891	69787	26
35	30275	99106	31168	68831	00894	69725	25
36	30336	99104	31233	68767	00896	69664	24
37	30398	99101	31297	68703	00899	69602	23
38	30459	99099	31361	68639	00901	69541	22
39	30521	99096	31425	68575	00904	69479	21
40	9. 30582	9. 99093	9. 31488	10. 68511	10. 00907	10. 69418	20
41	30643	99091	31552	68448	00909	69357	19
42	30704	99088	31616	68384	00912	69296	18
43	30765	99085	31679	68320	00914	69235	17
44	30826	99083	31743	68257	00917	69174	16
45	30887	99080	31806	68194	00920	69113	15
46	30947	99078	31870	68130	00922	69053	14
47	31008	99075	31933	68067	00925	68992	13
48	31068	99072	31996	68004	00928	68931	12
49	31129	99070	32059	67941	00930	68871	11
50	9. 31189	9. 99067	9. 32122	10. 67878	10. 00933	11. 68811	10
51	31249	99064	32185	67815	00936	68750	9
52	31310	99062	32248	67752	00938	68690	8
53	31370	99059	32311	67689	00941	68630	7
54	31430	99056	32373	67627	00943	68570	6
55	31490	99054	32436	67564	00946	68510	5
56	31549	99051	32498	67502	00949	68451	4
57	31609	99048	32561	67439	00951	68391	3
58	31669	99046	32623	67377	00954	68332	2
59	31728	99043	32685	67315	00957	68272	1
60	31788	99040	32747	67252	00960	68212	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 12 Degrees.

M.	Sine.	Co-sine.	Tang.	Co-tang.	Secant.	Co-secant.	
0	9. 31783	9. 99040	9. 32747	10. 67252	10. 00960	10. 68212	60
1	31847	99038	32809	67190	00963	68153	59
2	31907	99035	32871	67123	00965	68093	58
3	31966	99032	32933	67066	00968	68034	57
4	32025	99030	32995	67005	00970	67975	56
5	32084	99027	33057	66943	00973	67916	55
6	32143	99024	33119	66881	00976	67857	54
7	32202	99021	33180	66820	00978	67798	53
8	32261	99019	33242	66758	00981	67739	52
9	32319	99016	33303	66697	00984	67681	51
10	9. 32378	9. 99013	9. 33365	10. 66635	10. 00987	10. 67622	50
11	32437	99011	33426	66574	00989	67563	49
12	32495	99008	33487	66513	00992	67505	48
13	32553	99005	33548	66452	00995	67447	47
14	32612	99002	33609	66391	00997	67388	46
15	32670	99000	33670	66330	00999	67330	45
16	32728	98997	33731	66269	01003	67272	44
17	32786	98994	33792	66208	01006	67214	43
18	32844	98991	33853	66147	01008	67156	42
19	32902	98989	33913	66087	01011	67098	41
20	9. 32960	9. 98986	9. 33974	10. 66026	10. 01014	10. 97040	40
21	33018	98983	34034	65966	01017	66982	39
22	33075	98980	34095	65905	01020	66925	38
23	33133	98978	34155	65845	01022	66867	37
24	33190	98975	34215	65784	01025	66810	36
25	33248	98972	34276	65724	01028	66752	35
26	33305	98969	34336	65664	01031	66695	34
27	33362	98966	34396	65604	01033	66638	33
28	33419	98964	34456	65544	01036	66580	32
29	33477	98961	34516	65484	01039	66523	31
30	9. 33534	9. 98958	9. 34575	10. 65424	10. 01042	10. 66466	30
31	33591	98955	34635	65365	01045	66409	29
32	33647	98952	34695	65305	01047	66352	28
33	33704	98950	34754	65245	01050	66296	27
34	33761	98947	34814	65186	01053	66239	26
35	33818	98944	34873	65126	01056	66182	25
36	33874	98941	34933	65067	01059	66126	24
37	33931	98938	34992	65008	01062	66069	23
38	33987	98936	35051	64949	01064	66013	22
39	34043	98933	35111	64889	01067	65957	21
40	9. 34100	9. 98930	9. 35170	10. 64830	10. 01070	10. 65900	20
41	34156	98927	35229	64771	01073	65844	19
42	34212	98924	35288	64712	01076	65788	18
43	34268	98921	35346	64653	01079	65732	17
44	34324	98919	35405	64595	01081	65676	16
45	34380	98916	35464	64536	01084	65620	15
46	34435	98913	35523	64478	01087	65564	14
47	34491	98910	35581	64419	01090	65509	13
48	34547	98907	35640	64360	01093	65453	12
49	34602	98904	35698	64302	01096	65398	11
50	9. 34658	9. 98901	9. 35757	10. 64243	10. 01099	10. 65342	10
51	34713	98898	35815	64185	01101	65287	9
52	34769	98896	35873	64127	01104	65231	8
53	34824	98893	35931	64069	01107	65176	7
54	34879	98890	35989	64011	01110	65121	6
55	34934	98887	36047	63953	01113	65066	5
56	34989	98884	36105	63895	01116	65011	4
57	35044	98881	36163	63837	01119	64956	3
58	35099	98878	36221	63779	01122	64901	2
59	35154	98875	36279	63721	01125	64846	1
60	35209	98872	36336	63664	01128	64791	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 13 Degrees.

M.	Sine.	Co-sine.	Tang.	Co-tang.	Secant.	Co-secant.	
0	9. 35209	9. 98872	9. 36336	10. 63664	10. 01128	10. 64791	60
1	35263	98869	36394	63606	01130	64736	59
2	35318	98867	36451	63548	01133	64682	58
3	35373	98864	36509	63491	01136	64627	57
4	35427	98861	36566	63434	01139	64573	56
5	35481	98858	36624	63376	01142	64518	55
6	35536	98855	36681	63319	01145	64464	54
7	35590	98852	36738	63262	01148	64410	53
8	35644	98849	36795	63205	01151	64356	52
9	35698	98846	36852	63148	01154	64302	51
10	9. 35752	9. 98843	9. 36909	10. 63091	10. 01157	10. 64248	50
11	35806	98840	36966	63034	01160	64194	49
12	35860	98837	37023	62977	01163	64140	48
13	35914	98834	37080	62920	01166	64086	47
14	35968	98831	37137	62863	01169	64032	46
15	36021	98828	37193	62807	01172	63978	45
16	36075	98825	37250	62750	01175	63925	44
17	36129	98822	37306	62693	01178	63871	43
18	36182	98819	37363	62637	01181	63818	42
19	36236	98816	37419	62581	01184	63764	41
20	9. 36289	9. 98813	9. 37476	10. 62524	10. 01187	10. 63711	40
21	36342	98810	37532	62468	01190	63658	39
22	36395	98807	37588	62412	01193	63605	38
23	36448	98804	37644	62356	01196	63551	37
24	36502	98801	37700	62300	01199	63498	36
25	36555	98798	37756	62244	01202	63445	35
26	36607	98795	37812	62188	01205	63392	34
27	36660	98792	37868	62132	01208	63340	33
28	36713	98789	37924	62076	01211	63287	32
29	36766	98786	37980	62020	01214	63234	31
30	9. 36818	9. 98783	9. 38035	10. 61965	10. 01217	10. 63181	30
31	36871	98780	38091	61909	01220	63129	29
32	36924	98777	38146	61853	01223	63076	28
33	36976	98774	38202	61798	01226	63024	27
34	37028	98771	38257	61742	01229	62971	26
35	37081	98768	38313	61687	01232	62919	25
36	37133	98765	38368	61632	01235	62867	24
37	37185	98762	38423	61577	01238	62815	23
38	37237	98759	38479	61521	01241	62763	22
39	37289	98756	38534	61466	01244	62711	21
40	9. 37341	9. 98753	9. 38589	10. 61411	10. 01247	10. 62659	20
41	37393	98749	38644	61356	01250	62607	19
42	37445	98746	38699	61301	01253	62555	18
43	37497	98743	38754	61246	01257	62503	17
44	37549	98740	38808	61192	01260	62451	16
45	37600	98737	38863	61137	01263	62400	15
46	37652	98734	38918	61082	01266	62348	14
47	37704	98731	38972	61028	01269	62296	13
48	37755	98728	39027	60973	01272	62245	12
49	37806	98725	39081	60918	01275	62194	11
50	9. 37858	9. 98722	9. 39136	10. 60864	10. 01278	10. 62142	10
51	37909	98719	39190	60810	01281	62091	9
52	37960	98715	39245	60755	01284	62040	8
53	38011	98712	39299	60701	01288	61989	7
54	38062	98709	39353	60647	01291	61938	6
55	38113	98706	39407	60593	01294	61887	5
56	38164	98703	39461	60539	01297	61836	4
57	38215	98700	39515	60485	01300	61785	3
58	38266	98697	39569	60431	01303	61734	2
59	38317	98694	39623	60377	01306	61683	1
60	38367	98690	39677	60323	01310	61632	0
	Co sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 14 Degrees.

M.	Sine.	Co sine.	Tangent.	Co-tang.	Secants.	Co-secant.	
0	9. 38367	9. 98690	9. 39677	10. 60323	10. 01310	10. 61632	60
1	38418	98687	39731	60269	01313	61582	59
2	38469	98684	39785	60215	01316	61531	58
3	38519	98681	39838	60162	01319	61481	57
4	38570	98678	39892	60108	01322	61430	56
5	38620	98675	39945	60054	01325	61380	55
6	38670	98671	39999	60001	01329	61330	54
7	38721	98668	40052	59948	01332	61280	53
8	38771	98665	40106	59894	01335	61229	52
9	38821	98662	40159	59841	01338	61179	51
10	9. 38871	9. 98659	9. 40212	10. 59788	10. 01341	10. 61129	50
11	38922	98655	40266	59734	01344	61079	49
12	38971	98652	40319	59681	01348	61029	48
13	39021	98649	40372	59628	01351	60979	47
14	39071	98646	40425	59575	01354	60929	46
15	39121	98643	40478	59522	01357	60879	45
16	39170	98639	40531	59469	01360	60830	44
17	39220	98636	40584	59416	01364	60780	43
18	39269	98633	40636	59363	01367	60730	42
19	39319	98630	40689	59311	01371	60681	41
20	9. 39368	9. 98627	9. 40742	10. 59258	10. 01373	10. 60631	40
21	39418	98623	40794	59205	01377	60582	39
22	39467	98620	40847	59153	01380	60533	38
23	39517	98617	40900	59100	01383	60483	37
24	39566	98614	40952	59048	01386	60434	36
25	39615	98610	41004	58995	01390	60385	35
26	39664	98607	41057	58943	01393	60336	34
27	39713	98604	41109	58891	01396	60287	33
28	39762	98601	41161	58838	01399	60238	32
29	39811	98597	41214	58786	01403	60189	31
30	9. 39862	9. 98594	9. 41266	10. 58734	10. 01406	10. 60140	30
31	39909	98591	41318	58682	01409	60091	29
32	39957	98588	41370	58630	01412	60042	28
33	40006	98584	41422	58578	01416	59994	27
34	40055	98581	41474	58526	01419	59945	26
35	40103	98578	41526	58474	01422	59896	25
36	40152	98574	41577	58422	01425	59848	24
37	40200	98571	41629	58371	01429	59799	23
38	40249	98568	41681	58319	01432	59751	22
39	40297	98565	41733	58267	01435	59703	21
40	9. 40345	9. 98561	9. 41784	10. 58216	10. 01439	10. 59654	20
41	40394	98558	41836	58164	01442	59606	19
42	40442	98555	41887	58113	01445	59558	18
43	40490	98551	41939	58061	01449	59510	17
44	40538	98548	41990	58010	01452	59462	16
45	40586	98545	42041	57958	01455	59414	15
46	40634	98541	42093	57907	01459	59366	14
47	40682	98538	42144	57856	01462	59318	13
48	40730	98535	42195	57805	01465	59270	12
49	40778	98531	42246	57754	01469	59222	11
50	9. 40825	9. 98528	9. 42297	10. 57703	10. 01472	10. 59175	10
51	40873	98525	42348	57652	01475	59126	9
52	40921	98521	42399	57601	01479	59079	8
53	40968	98518	42450	57550	01482	59032	7
54	41016	98515	42501	57499	01485	58984	6
55	41063	98511	42552	57448	01489	58937	5
56	41111	98508	42603	57397	01492	58889	4
57	41158	98504	42653	57347	01495	58842	3
58	41205	98501	42704	57296	01499	58795	2
59	41252	98498	42755	57245	01502	58748	1
60	41300	98494	42805	57195	01505	58700	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 15 Degrees.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9. 41300	9. 98494	9. 42805	10. 57195	10. 01506	10. 58700	60
1	41347	98491	42856	57144	01509	58653	59
2	41394	98488	42906	57094	01512	58606	58
3	41441	98484	42957	57043	01516	58559	57
4	41488	98481	43007	56993	01519	58512	56
5	41535	98477	43057	56943	01523	58465	55
6	41581	98474	43107	56892	01526	58418	54
7	41628	98471	43158	56842	01529	58372	53
8	41675	98467	43208	56792	01533	58325	52
9	41722	98464	43258	56742	01536	58278	51
10	9. 41768	9. 98460	9. 43308	10. 56692	10. 01540	10. 58232	50
11	41815	98457	43358	56642	01543	58185	49
12	41861	98453	43408	56592	01546	58138	48
13	41908	98450	43458	56542	01550	58092	47
14	41954	98447	43508	56492	01553	58046	46
15	42001	98443	43558	56442	01557	57999	45
16	42047	98440	43607	56393	01560	57953	44
17	42093	98436	43657	56343	01564	57907	43
18	42139	98433	43707	56293	01567	57860	42
19	42186	98429	43756	56244	01571	57814	41
20	9. 42232	9. 98426	9. 43806	10. 56194	10. 01574	10. 57768	40
21	42278	98422	43855	56145	01578	57722	39
22	42324	98419	43905	56095	01581	57676	38
23	42370	98415	43954	56046	01584	57630	37
24	42416	98412	44004	55996	01588	57584	36
25	42461	98408	44053	55947	01591	57538	35
26	42507	98405	44102	55898	01595	57493	34
27	42553	98401	44151	55848	01598	57447	33
28	42599	98398	44201	55799	01602	57401	32
29	42644	98394	44250	55750	01605	57356	31
30	9. 42690	9. 98391	9. 44299	10. 55701	10. 01608	10. 57310	30
31	42735	98387	44348	55652	01612	57265	29
32	42781	98384	44397	55603	01616	57219	28
33	42826	98380	44446	55554	01619	57174	27
34	42872	98377	44495	55505	01623	57128	26
35	42917	98373	44543	55456	01626	57083	25
36	42962	98370	44592	55408	01630	57038	24
37	43007	98366	44641	55359	01634	56992	23
38	43053	98363	44690	55310	01637	56947	22
39	43098	98359	44738	55262	01641	56902	21
40	9. 43143	9. 98356	9. 44787	10. 55213	10. 01644	10. 56857	20
41	43188	98352	44836	55164	01648	56812	19
42	43233	98349	44884	55116	01651	56767	18
43	43278	98345	44933	55067	01655	56722	17
44	43323	98342	44981	55019	01658	56677	16
45	43367	98338	45029	54971	01662	56632	15
46	43412	98334	45078	54922	01665	56588	14
47	43457	98331	45126	54874	01669	56543	13
48	43502	98327	45174	54826	01673	56498	12
49	43546	98324	45222	54777	01679	56454	11
50	9. 43591	9. 98320	9. 45271	10. 54729	10. 01680	10. 56409	10
51	43635	98317	45319	54681	01683	56365	9
52	43680	98313	45367	54633	01687	56320	8
53	43724	98309	45415	54585	01691	56276	7
54	43769	98306	45463	54537	01694	56231	6
55	43813	98302	45511	54489	01698	56187	5
56	43857	98299	45559	54441	01701	56143	4
57	43901	98295	45606	54394	01705	56099	3
58	43946	98291	45654	54346	01709	56054	2
59	43990	98288	45702	54298	01712	56010	1
60	44034	98284	45751	54250	01716	55966	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 16 Degrees.

M.	S. no.	Co-line.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9. 44034	9. 98284	9. 45750	10. 54250	10. 01716	10. 55966	60
1	44073	98280	45797	54203	01719	55922	59
2	44122	98277	45845	54155	01723	55878	58
3	44166	98273	45892	54107	01727	55834	57
4	44210	98270	45940	54060	01730	55790	56
5	44253	98266	45987	54012	01734	55746	55
6	44297	98262	46035	53965	01738	55703	54
7	44341	98259	46082	53918	01741	55659	53
8	44385	98255	46130	53870	01745	55615	52
9	44428	98251	46177	53823	01749	55572	51
10	9. 44472	9. 98248	9. 46224	10. 53776	10. 01752	10. 55528	50
11	44515	98244	46271	53728	01756	55484	49
12	44559	98240	46319	53681	01760	55441	48
13	44602	98237	46366	53634	01763	55397	47
14	44646	98233	46413	53587	01767	55354	46
15	44689	98229	46460	53540	01771	55311	45
16	44733	98226	46507	53493	01774	55267	44
17	44776	98222	46554	53446	01778	55224	43
18	44819	98218	46601	53399	01782	55181	42
19	44862	98215	46648	53352	01785	55138	41
20	9. 44905	9. 98211	9. 46694	10. 53305	10. 01789	10. 55095	40
21	44948	98207	46741	53269	01793	55051	39
22	44991	98203	46788	53212	01796	55008	38
23	45034	98200	46835	53165	01800	54965	37
24	45077	98196	46881	53119	01804	54922	36
25	45120	98192	46928	53072	01808	54880	35
26	45163	98189	46975	53025	01811	54837	34
27	45206	98185	47021	52979	01815	54794	33
28	45249	98181	47068	52932	01819	54751	32
29	45291	98177	47114	52886	01823	54708	31
30	9. 45334	9. 98174	9. 47160	10. 52839	10. 01826	10. 54666	30
31	45377	98170	47207	52793	01830	54624	29
32	45419	98166	47253	52747	01834	54581	28
33	45462	98162	47299	52700	01838	54538	27
34	45504	98159	47346	52654	01841	54496	26
35	45547	98155	47392	52608	01845	54453	25
36	45589	98151	47438	52562	01849	54411	24
37	45632	98148	47484	52516	01853	54368	23
38	45674	98144	47530	52470	01856	54326	22
39	45716	98140	47576	52424	01860	54284	21
40	9. 45758	9. 98136	9. 47622	10. 52378	10. 01864	10. 54242	20
41	45801	98132	47668	52332	01868	54199	19
42	45843	98128	47714	52286	01871	54157	18
43	45885	98125	47760	52240	01875	54115	17
44	45927	98121	47806	52194	01879	54073	16
45	45969	98117	47852	52148	01883	54031	15
46	46011	98113	47897	52102	01887	53989	14
47	46053	98109	47943	52057	01890	53947	13
48	46095	98106	47986	52011	01894	53905	12
49	46136	98102	48034	51965	01898	53864	11
50	9. 46178	9. 98098	9. 48080	10. 51920	10. 01902	10. 53822	10
51	46222	98094	48126	51874	01906	53780	9
52	46260	98090	48171	51829	01910	53738	8
53	46303	98087	48217	51783	01913	53697	7
54	46345	98083	48262	51738	01917	53655	6
55	46386	98079	48307	51692	01921	53614	5
56	46428	98075	48353	51647	01925	53572	4
57	46469	98071	48398	51602	01929	53531	3
58	46511	98067	48443	51556	01933	53589	2
59	46552	98063	48489	51511	01936	53448	1
60	46593	98060	48534	51466	01940	53406	0
	Co-line.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 17 Degrees.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.46593	9.98060	9.48534	10.51466	10.01940	10.53406	60
1	46635	98056	48579	51421	01944	53365	59
2	46676	98052	48624	51376	01948	53324	58
3	46717	98048	48669	51331	01952	53283	57
4	46758	98044	48714	51286	01956	53241	56
5	46800	98040	48759	51241	01960	53200	55
6	46841	98036	48804	51196	01964	53159	54
7	46882	98032	48849	51151	01968	53118	53
8	46923	98029	48894	51106	01971	53077	52
9	46964	98025	48939	51061	01975	53036	51
10	9.47005	9.98021	9.48984	10.51016	10.01979	10.52995	50
11	47045	98017	49029	50971	01983	52954	49
12	47086	98013	49073	50927	01987	52914	48
13	47127	98009	49118	50882	01991	52873	47
14	47168	98005	49163	50837	01995	52832	46
15	47209	98001	49207	50793	01999	52791	45
16	47249	97997	49252	50748	02003	52751	44
17	47290	97993	49296	50703	02007	52710	43
18	47330	97989	49341	50659	02010	52670	42
19	47371	97985	49385	50614	02014	52629	41
20	9.47411	9.97982	9.49430	10.50570	10.02018	10.52588	40
21	47452	97978	49474	50526	02022	52548	39
22	47492	97974	49519	50481	02026	52508	38
23	47533	97970	49563	50437	02030	52467	37
24	47573	97966	49607	50393	02034	52427	36
25	47613	97962	49651	50348	02038	52387	35
26	47654	97958	49696	50304	02042	52346	34
27	47694	97954	49740	50260	02056	52306	33
28	47734	97950	49784	50216	02050	52266	32
29	47774	97946	49828	50172	02054	52226	31
30	9.47814	9.97942	9.49872	10.50128	10.02058	10.52186	30
31	47854	97938	49916	50084	02062	52146	29
32	47894	97934	49960	50040	02066	52106	28
33	47934	97930	50004	49996	02070	52066	27
34	47974	97926	50048	49952	02074	52026	26
35	48014	97922	50092	49908	02078	51986	25
36	48054	97918	50136	49864	02082	51946	24
37	48094	97914	50180	49820	02086	51906	23
38	48133	97910	50223	49776	02090	51867	22
39	48173	97906	50267	49733	02094	51827	21
40	9.48213	9.97902	9.50311	10.49689	10.02098	10.51787	20
41	48252	97898	50355	49645	02102	51747	19
42	48292	97894	50398	49602	02106	51708	18
43	48332	97890	50442	49558	02110	51668	17
44	48371	97886	50485	49515	02114	51629	16
45	48411	97882	50529	49471	02118	51589	15
46	48450	97878	50572	49428	02122	51550	14
47	48489	97874	50616	49384	02126	51510	13
48	48529	97870	50659	49341	02130	51471	12
49	48568	97866	50703	49297	02134	51432	11
50	9.48607	9.97861	9.50746	10.49254	10.02138	10.51392	10
51	48647	97857	50789	49211	02143	51353	9
52	48686	97853	50833	49167	02147	51314	8
53	48725	97849	50876	49124	02151	51275	7
54	48764	97845	50919	49081	02155	51236	6
55	48803	97841	50962	49038	02159	51197	5
56	48842	97837	51005	48995	02163	51158	4
57	48881	97833	51048	48951	02167	51119	3
58	48920	97829	51092	48908	02171	51080	2
59	48959	97825	51135	48865	02175	51041	1
60	48998	97822	51178	48821	02180	51002	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 18 Degrees.

M.	Sine.	Co-line.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.48998	9.97821	9.51178	10.48322	10.02177	10.51032	60
1	49037	97817	51221	48779	02183	50963	59
2	49076	97812	51263	48730	02188	50924	58
3	49115	97808	51306	48694	02192	50885	57
4	49153	97804	51349	48651	02196	50847	56
5	49192	97800	51392	48608	02200	50808	55
6	49231	97796	51435	48565	02204	50769	54
7	49269	97792	51478	48522	02208	50730	53
8	49308	97788	51520	48480	02212	50692	52
9	49347	97783	51563	48437	02217	50653	51
10	9.49385	9.97779	9.51606	10.48394	10.02221	10.50615	50
11	49424	97775	51648	48352	02225	50576	49
12	49462	97771	51691	48309	02229	50538	48
13	49500	97767	51733	48266	02233	50499	47
14	49539	97763	51776	48224	02237	50461	46
15	49577	97759	51818	48181	02241	50423	45
16	49615	97754	51861	48139	02246	50385	44
17	49654	97750	51903	48097	02250	50346	43
18	49692	97746	51946	48054	02254	50308	42
19	49730	97742	51988	48012	02258	50270	41
20	9.49768	9.97738	9.52030	10.47969	10.02262	10.50232	40
21	49806	97733	52073	47927	02266	50194	39
22	49840	97729	52115	47885	02271	50156	38
23	49882	97725	52157	47843	02275	50118	37
24	49924	97721	52199	47800	02279	50080	36
25	49958	97717	52242	47758	02283	50042	35
26	49996	97712	52284	47716	02287	50004	34
27	50034	97708	52326	47674	02292	49966	33
28	50072	97704	52368	47632	02296	49928	32
29	50110	97700	52410	47590	02300	49890	31
30	9.50148	9.97696	9.52452	10.47548	10.02304	10.49852	30
31	50185	97691	52494	47506	02309	49815	29
32	50223	97687	52536	47464	02313	49777	28
33	50261	97683	52578	47422	02317	49739	27
34	50298	97679	52620	47380	02321	49702	26
35	50336	97674	52661	47338	02325	49664	25
36	50373	97670	52703	47297	02330	49626	24
37	50411	97666	52745	47255	02334	49589	23
38	50448	97662	52787	47213	02338	49551	22
39	50486	97657	52828	47171	02343	49514	21
40	9.50523	9.97653	9.52870	10.47130	10.02347	10.49477	20
41	50561	97649	52912	47088	02351	49439	19
42	50598	97645	52953	47046	02355	49402	18
43	50635	97640	52995	47005	02360	49365	17
44	50673	97636	53037	46963	02364	49327	16
45	50710	97632	53078	46922	02368	49290	15
46	50747	97627	53120	46880	02372	49253	14
47	50784	97623	53161	46839	02377	49216	13
48	50821	97619	53202	46797	02381	49179	12
49	50858	97615	53244	46756	02385	49141	11
50	9.50896	9.97610	9.53285	10.46715	10.02390	10.49104	10
51	50933	97606	53327	46713	02394	49067	9
52	50970	97602	53368	46672	02398	49030	8
53	51006	97597	53409	46631	02403	48994	7
54	51043	97593	53450	46590	02407	48957	6
55	51080	97589	53492	46549	02411	48920	5
56	51117	97584	53533	46508	02416	48883	4
57	51154	97580	53574	46467	02420	48846	3
58	51191	97576	53615	46426	02424	48809	2
59	51227	97571	53656	46385	02429	48772	1
60	51264	97567	53698	46343	02433	48736	0
	Co-line.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 19 Degrees.

M.	Sine.	Co-sine.	Tang.	Co-tang.	Secant.	Co-secant.	
0	9. 51264	9. 97567	9. 53697	10. 46303	10. 02433	10. 48736	60
1	51301	97563	53738	46262	02437	48609	59
2	51337	97558	53779	46221	02442	48662	58
3	51374	97554	53820	46180	02446	48626	57
4	51411	97550	53861	46139	02450	48589	56
5	51447	97545	53902	46098	02455	48553	55
6	51484	97541	53943	46057	02459	48516	54
7	51520	97536	53984	46016	02463	48480	53
8	51557	97532	54024	45975	02468	48443	52
9	51593	97528	54065	45935	02472	48407	51
10	9. 51629	9. 97523	9. 54106	10. 45894	10. 02477	10. 48371	50
11	51666	97519	54147	45853	02481	48334	49
12	51702	97514	54187	45812	02485	48298	48
13	51738	97510	54228	45772	02490	48262	47
14	51774	97506	54269	45731	02494	48225	46
15	51811	97501	54309	45691	02499	48189	45
16	51847	97497	54350	45650	02503	48153	44
17	51883	97492	54390	45609	02507	48117	43
18	51919	97488	54431	45569	02512	48081	42
19	51955	97484	54471	45528	02516	48045	41
20	9. 51991	9. 97479	9. 54512	10. 45488	10. 02521	10. 48009	40
21	52027	97475	54552	45448	02525	47973	39
22	52063	97470	54593	45407	02530	47937	38
23	52099	97466	54633	45367	02534	47901	37
24	52135	97461	54673	45326	02539	47865	36
25	52171	97457	54714	45286	02543	47829	35
26	52207	97452	54754	45246	02547	47793	34
27	52242	97448	54794	45206	02552	47758	33
28	52278	97444	54834	45165	02556	47721	32
29	52314	97439	54875	45125	02561	47686	31
30	9. 52349	9. 97435	9. 54915	10. 45085	10. 02565	10. 47650	30
31	52385	97430	54955	45045	02570	47615	29
32	52421	97426	54995	45005	02574	47579	28
33	52456	97421	55035	44965	02579	47544	27
34	52492	97417	55075	44925	02583	47508	26
35	52527	97412	55115	44885	02588	47472	25
36	52563	97408	55155	44845	02592	47437	24
37	52598	97403	55195	44805	02597	47402	23
38	52634	97399	55235	44765	02601	47366	22
39	52669	97394	55275	44725	02606	47331	21
40	9. 52705	9. 97390	9. 55315	10. 44685	10. 02610	10. 47295	20
41	52740	97385	55355	44645	02615	47260	19
42	52775	97381	55395	44605	02619	47225	18
43	52810	97376	55434	44566	02624	47189	17
44	52846	97372	55474	44526	02628	47154	16
45	52881	97367	55514	44486	02633	47119	15
46	52916	97362	55554	44446	02637	47084	14
47	52951	97358	55593	44407	02642	47049	13
48	52986	97353	55633	44367	02646	47014	12
49	53021	97349	55673	44327	02651	46978	11
50	9. 53056	9. 97344	9. 55712	10. 44288	10. 02656	10. 46943	10
51	53091	97340	55752	44248	02660	46908	9
52	53126	97335	55791	44209	02665	46873	8
53	53161	97331	55831	44169	02669	46839	7
54	53196	97326	55870	44130	02674	46804	6
55	53231	97321	55910	44090	02678	46769	5
56	53266	97317	55949	44051	02683	46734	4
57	53301	97312	55988	44011	02688	46699	3
58	53336	97308	56028	43972	02692	46664	2
59	53370	97303	56067	43933	02697	46630	1
60	53405	97299	56107	43893	02701	46595	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 20 Degrees.

M.	Sine.	Co-sine.	Tang.	Co-tang.	Secant.	Co-secant.	
0	9. 53405	9. 97299	9. 56107	10. 43893	10. 02701	10. 46595	60
1	53440	97294	56146	43854	02706	46560	59
2	53474	97289	56185	43814	02710	46525	58
3	53509	97285	56224	43776	02715	46491	57
4	53544	97280	56264	43736	02720	46456	56
5	53578	97275	56303	43697	02724	46422	55
6	53613	97271	56342	43658	02729	46387	54
7	53647	97266	56381	43619	02734	46353	53
8	53682	97262	56420	43580	02738	46318	52
9	53716	97257	56459	43541	02743	46284	51
10	9. 53751	9. 97252	9. 56498	10. 43502	10. 02748	10. 46249	50
11	53785	97248	56537	43463	02752	46215	49
12	53819	97243	56576	43424	02757	46181	48
13	53854	97238	56615	43385	02762	46146	47
14	53888	97234	56654	43346	02766	46112	46
15	53922	97229	56693	43307	02771	46078	45
16	53956	97224	56732	43268	02775	46043	44
17	53991	97220	56771	43229	02780	46009	43
18	54025	97215	56810	43190	02785	45975	42
19	54059	97210	56849	43151	02789	45941	41
20	9. 54093	9. 97206	9. 56887	10. 43113	10. 02794	10. 45907	40
21	54127	97201	56926	43074	02799	45873	39
22	54161	97196	56965	43035	02804	45839	38
23	54195	97192	57003	42996	02808	45805	37
24	54229	97187	57042	42958	02813	45771	36
25	54263	97182	57081	42919	02818	45737	35
26	54297	97178	57119	42880	02822	45703	34
27	54331	97173	57158	42842	02827	45669	33
28	54365	97168	57197	42803	02832	45635	32
29	54399	97163	57235	42765	02836	45601	31
30	9. 54432	9. 97159	9. 57274	10. 42726	10. 02841	10. 45567	30
31	54466	97154	57312	42688	02846	45534	29
32	54500	97149	57351	42649	02851	45500	28
33	54534	97145	57389	42611	02855	45466	27
34	54567	97140	57428	42572	02860	45433	26
35	54601	97135	57466	42534	02865	45399	25
36	54635	97130	57504	42496	02870	45365	24
37	54668	97126	57543	42457	02874	45332	23
38	54702	97121	57581	42419	02879	45298	22
39	54735	97116	57619	42381	02884	45265	21
40	9. 54769	9. 97111	9. 57658	10. 42342	10. 02889	10. 45231	20
41	54802	97106	57696	42304	02893	45198	19
42	54836	97102	57734	42266	02898	45164	18
43	54869	97097	57772	42228	02903	45131	17
44	54903	97092	57810	42190	02908	45097	16
45	54936	97087	57849	42151	02913	45064	15
46	54969	97083	57887	42113	02917	45031	14
47	55003	97078	57925	42075	02922	44997	13
48	55036	97073	57963	42037	02927	44964	12
49	55069	97068	57901	41999	02932	44931	11
50	9. 55102	9. 97063	9. 58039	10. 41961	10. 02936	10. 44898	10
51	55136	97059	58077	41923	02941	44864	9
52	55169	97054	58115	41885	02946	44831	8
53	55202	97049	58153	41847	02951	44798	7
54	55235	97044	58191	41809	02956	44765	6
55	55268	97039	58229	41771	02961	44732	5
56	55301	97034	58266	41733	02965	44699	4
57	55334	97030	58304	41696	02970	44666	3
58	55367	97025	58342	41658	02975	44633	2
59	55400	97020	58380	41620	02980	44600	1
60	55433	97015	58418	41582	02985	44567	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 21 Degrees.

M.	Sine.	Co-fine.	Tang.	Co-tang.	Secant.	Co-secant.	
0	9. 55433	9. 97015	9. 58418	10. 41582	10. 02985	10. 44568	60
1	55466	97010	58455	41544	02990	44534	59
2	55499	97005	58493	41507	02994	44501	58
3	55531	97001	58531	41469	02999	44468	57
4	55564	96996	58569	41431	03004	44436	56
5	55597	96991	58606	41394	03009	44403	55
6	55630	96986	58644	41356	03014	44370	54
7	55663	96981	58681	41318	03019	44337	53
8	55695	96976	58719	41281	03023	44305	52
9	55728	96971	58757	41243	03029	44272	51
10	9. 55761	9. 96966	9. 58794	10. 41206	10. 03033	10. 44239	50
11	55793	96962	58832	41168	03038	44207	49
12	55826	96957	58869	41131	03043	44174	48
13	55858	96952	58907	41093	03048	44142	47
14	55891	96947	58944	41056	03053	44109	46
15	55923	96942	58981	41019	03058	44077	45
16	55956	96937	59019	40981	03063	44044	44
17	55988	96932	59056	40944	03068	44012	43
18	56021	96927	59093	40906	03073	43979	42
19	56053	96922	59131	40869	03078	43947	41
20	9. 56085	9. 96917	9. 59168	10. 40832	10. 03083	10. 43914	40
21	56118	96912	59205	40795	03088	43882	39
22	56150	96907	59243	40757	03093	43850	38
23	56182	96902	59280	40720	03097	43818	37
24	56215	96898	59317	40683	03102	43785	36
25	56247	96893	59354	40646	03107	43753	35
26	56279	96888	59391	40609	03112	43721	34
27	56311	96883	59428	40571	03117	43689	33
28	56343	96878	59466	40534	03122	43657	32
29	56375	96873	59503	40497	03127	43624	31
30	9. 56407	9. 96868	9. 59540	10. 40460	10. 03132	10. 43592	30
31	56440	96863	59577	40423	03137	43560	29
32	56472	96858	59614	40386	03142	43528	28
33	56504	96853	59651	40349	03147	43496	27
34	56536	96848	59688	40312	03152	43464	26
35	56568	96843	59725	40275	03157	43432	25
36	56599	96838	59762	40238	03162	43400	24
37	56631	96833	59798	40201	03167	43369	23
38	56663	96828	59835	40165	03172	43337	22
39	56695	96823	59872	40128	03177	43305	21
40	9. 56727	9. 96818	9. 59909	10. 40091	10. 03182	10. 43273	20
41	56759	96813	59946	40054	03187	43241	19
42	56790	96808	59983	40017	03192	43210	18
43	56822	96803	60019	39981	03197	43178	17
44	56854	96798	60056	39944	03202	43146	16
45	56885	96793	60093	39907	03207	43114	15
46	56917	96788	60130	39870	03212	43083	14
47	56949	96783	60166	39834	03217	43051	13
48	56980	96777	60203	39797	03222	43020	12
49	57012	96772	60239	39760	03227	42988	11
50	9. 57043	9. 96767	9. 60276	10. 39724	10. 03232	10. 42956	10
51	57075	96762	60313	39687	03238	42925	9
52	57107	96757	60349	39651	03243	42893	8
53	57138	96752	60386	39614	03248	42862	7
54	57169	96747	60422	39578	03253	42830	6
55	57201	96742	60459	39541	03258	42799	5
56	57232	96737	60495	39505	03263	42768	4
57	57264	96732	60532	39468	03268	42736	3
58	57295	96727	60568	39432	03273	42705	2
59	57326	96722	60605	39395	03278	42674	1
60	57357	96717	60641	39359	03283	42642	0
	Co fine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 24 Degrees.

M.	Sine.	Co sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9. 60931	9. 96073	9. 64858	10. 35142	10. 03927	10. 39069	60
1	60960	96067	64896	35108	03935	39040	59
2	60988	96062	64922	35074	03938	39012	58
3	61016	96059	64960	35044	03944	38984	57
4	61045	96050	64994	35006	03949	38955	56
5	61073	96045	65028	34972	03955	38927	55
6	61101	96039	65062	34938	03961	38899	54
7	61129	96035	65096	34904	03967	38871	53
8	61158	96028	65130	34870	03972	38842	52
9	61189	96022	65146	34836	03978	38814	51
10	9. 61214	9. 96010	9. 65197	10. 34803	10. 03983	10. 38786	50
11	61242	96011	65231	34769	03989	38758	49
12	61270	96005	65265	34735	03995	38720	48
13	61298	95999	65299	34701	04000	38702	47
14	61326	95994	65333	34667	04006	38674	46
15	61354	95988	65366	34634	04012	38645	45
16	61382	95982	65400	34600	04017	38617	44
17	61410	95977	65434	34566	04023	38589	43
18	61438	95971	65467	34533	04029	38561	42
19	61466	95965	65501	34499	04034	38533	41
20	9. 61494	9. 95960	9. 65535	10. 34465	10. 04040	10. 38506	40
21	61512	95954	65568	34432	04046	38478	39
22	61550	95948	65602	34398	04052	38450	38
23	61578	95942	65636	34364	04057	38422	37
24	61606	95937	65669	34331	04063	38394	36
25	61634	95931	65703	34297	04069	38366	35
26	61662	95925	65736	34264	04075	38338	34
27	61689	95919	65770	34230	04080	38311	33
28	61717	95914	65803	34197	04086	38283	32
29	61745	95908	65837	34163	04092	38255	31
30	9. 61773	9. 95902	9. 65870	10. 34130	10. 04098	10. 38227	30
31	61800	95896	65904	34096	04103	38199	29
32	61828	95891	65937	34063	04109	38172	28
33	61856	95885	65974	34029	04115	38144	27
34	61883	95879	66004	33996	04121	38117	26
35	61911	95873	66038	33962	04127	38089	25
36	61939	95868	66071	33929	04132	38061	24
37	61966	95862	66104	33896	04148	38034	23
38	61994	95856	66138	33862	04144	38006	22
39	62021	95850	66171	33829	04150	37979	21
40	9. 62049	9. 95844	9. 66204	10. 33796	10. 04155	10. 37951	20
41	62076	95838	66238	33762	04161	37924	19
42	62104	95833	66271	33729	04167	37896	18
43	62131	95827	66304	33696	04173	37869	17
44	62159	95821	66337	33662	04179	37841	16
45	62186	95815	66371	33629	04185	37814	15
46	62213	95810	66404	33596	04190	37786	14
47	62241	95804	66437	33563	04196	37759	13
48	62268	95798	66470	33530	04202	37732	12
49	62296	95792	66503	33496	04208	37704	11
50	9. 62323	9. 95786	9. 66537	10. 33463	10. 04214	10. 37677	10
51	62350	95780	66570	33430	04220	37650	9
52	62377	95775	66603	33394	04225	37623	8
53	62405	95769	66636	33367	04231	37595	7
54	62432	95763	66669	33331	04237	37568	6
55	62459	95757	66702	33298	04243	37541	5
56	62486	95751	66735	33265	04249	37514	4
57	62513	95745	66768	33232	04255	37486	3
58	62541	95736	66801	33199	04261	37459	2
59	62568	95733	66834	33166	04266	37432	1
60	62595	95728	66867	33133	04272	37405	0
Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.	

A Table of Artificial Sines, Tang. and Sec. 25 Degrees.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secan.	Co-secant.	
0	9. 62595	9. 95728	9. 66867	10. 33133	10. 04272	10. 37405	60
1	62622	95722	66900	33100	04278	37378	59
2	62649	95716	66933	33067	04284	37351	58
3	62676	95710	66966	33034	04290	37324	57
4	62703	95704	66999	33001	04296	37297	56
5	62730	95698	67032	32968	04302	37270	55
6	62757	95692	67065	32935	04308	37243	54
7	62784	95686	67098	32902	04314	37216	53
8	62811	95680	67131	32869	04320	37189	52
9	62838	95674	67163	32836	04326	37162	51
10	9. 62865	9. 95668	9. 67196	10. 32804	10. 04332	10. 37135	50
11	62892	95662	67229	32771	04337	37108	49
12	62918	95657	67262	32738	04343	37082	48
13	62945	95651	67295	32705	04349	37055	47
14	62972	95645	67327	32672	04355	37028	46
15	62999	95639	67360	32640	04361	37001	45
16	63025	95633	67393	32607	04367	36974	44
17	63052	95627	67426	32574	04373	36948	43
18	63079	95621	67458	32542	04379	36921	42
19	63106	95615	67491	32509	04385	36894	41
20	9. 63133	9. 95609	9. 67524	10. 32476	10. 04391	10. 36867	40
21	63160	95603	67556	32444	04397	36841	39
22	63186	95597	67589	32411	04403	36814	38
23	63212	95591	67622	32378	04409	36787	37
24	63239	95585	67654	32346	04415	36761	36
25	63266	95579	67687	32313	04421	36734	35
26	63292	95573	67719	32281	04427	36708	34
27	63319	95567	67752	32248	04433	36681	33
28	63345	95561	67785	32215	04439	36655	32
29	63372	95555	67817	32183	04445	36628	31
30	9. 63398	9. 95549	9. 67850	10. 32150	10. 04451	10. 36602	30
31	63425	95543	67882	32118	04457	36575	29
32	63451	95537	67915	32085	04463	36549	28
33	63478	95531	67947	32053	04469	36522	27
34	63504	95525	67979	32020	04475	36496	26
35	63531	95519	68012	31988	04481	36469	25
36	63557	95523	68044	31956	04487	36443	24
37	63583	95516	68077	31925	04493	36417	23
38	63610	95500	68109	31891	04499	36390	22
39	63639	95494	68142	31858	04505	36364	21
40	9. 63662	9. 95488	9. 68174	10. 31826	10. 04511	10. 36338	20
41	63689	95482	68206	31794	04518	36311	19
42	63715	95476	68239	31761	04524	36285	18
43	63741	95470	68271	31729	04530	36259	17
44	63767	95464	68303	31697	04536	36233	16
45	63793	95458	68336	31664	04542	36206	15
46	63820	95452	68368	31632	04548	36180	14
47	63846	95446	68400	31600	04554	36154	13
48	63872	95440	68432	31568	04560	36128	12
49	63898	95433	68465	31535	04566	36102	11
50	9. 63924	9. 95427	9. 68497	10. 31503	10. 04572	10. 36076	10
51	63950	95421	68529	31471	04579	36050	9
52	63976	95415	68561	31439	04585	36024	8
53	64002	95409	68593	31407	04591	35998	7
54	64028	95403	68625	31374	04597	35972	6
55	64054	95397	68658	31342	04603	35946	5
56	64080	95391	68690	31310	04609	35920	4
57	64106	95384	68722	31278	04615	35894	3
58	64132	95378	68754	31246	04622	35868	2
59	64158	95372	68786	31214	04628	35842	1
60	64184	95366	68818	31182	04634	35816	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 26 Degrees.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9. 64184	9. 95366	9. 68818	10. 31182	10. 04634	10. 35816	60
1	64210	95360	68850	31149	04640	35790	59
2	64236	95354	68882	31118	04646	35764	58
3	64262	95347	68914	31086	04652	35738	57
4	64288	95341	68946	31054	04659	35712	56
5	64313	95335	68978	31022	04665	35686	55
6	64339	95329	69010	30990	04671	35661	54
7	64365	95323	69042	30956	04677	35635	53
8	64391	95317	69074	30928	04683	35609	52
9	64416	95310	69106	30894	04690	35583	51
10	9. 64442	9. 95304	9. 69138	10. 30862	10. 04696	10. 35558	50
11	64468	95298	69170	30830	04702	35532	49
12	64494	95292	69202	30798	04708	35506	48
13	64519	95285	69234	30766	04714	35481	47
14	64545	95279	69266	30734	04721	35455	46
15	64571	95273	69297	30702	04727	35429	45
16	64596	95267	69329	30671	04733	35404	44
17	64622	95261	69361	30639	04739	35378	43
18	64647	95254	69393	30607	04746	35353	42
19	64673	95248	69425	30575	04752	35327	41
20	9. 64698	9. 95242	9. 69457	10. 30543	10. 04758	10. 35302	40
21	64724	95236	69488	30512	04764	35276	39
22	64749	95229	69520	30480	04771	35251	38
23	64775	95223	69552	30448	04777	35225	37
24	64800	95217	69583	30416	04783	35200	36
25	64826	95210	69615	30385	04789	35174	35
26	64851	95204	69647	30353	04796	35149	34
27	64877	95198	69679	30321	04802	35123	33
28	64902	95192	69710	30290	04808	35098	32
29	64927	95185	69742	30258	04815	35073	31
30	9. 64953	9. 95179	9. 69774	10. 30226	10. 04821	10. 35047	30
31	65078	95173	69805	30195	04827	35022	29
32	65003	95166	69837	30163	04833	34997	28
33	65029	95160	69868	30131	04840	34971	27
34	65054	95154	69900	30100	04846	34946	26
35	65079	95148	69932	30068	04852	34921	25
36	65104	95141	69963	30037	04859	34896	24
37	65130	95135	69995	30005	04865	34870	23
38	65155	95129	70026	29974	04871	34845	22
39	65180	95122	70058	29942	04878	34820	21
40	9. 65205	9. 95116	9. 70089	10. 29911	10. 04884	10. 34795	20
41	65230	95110	70121	29879	04890	34770	19
42	65255	95103	70152	29848	04897	34744	18
43	65281	95097	70184	29816	04903	34719	17
44	65306	95090	70215	29785	04909	34694	16
45	65331	95084	70247	29753	04916	34669	15
46	65356	95078	70278	29722	04922	34644	14
47	65381	95071	70309	29690	04929	34619	13
48	65406	95065	70341	29659	04935	34594	12
49	65431	95059	70372	29628	04941	34569	11
50	9. 65456	9. 95052	9. 70404	10. 29596	10. 04948	10. 34544	10
51	65481	95046	70435	29565	04954	34519	9
52	65506	95039	70466	29534	04961	34494	8
53	65531	95033	70498	29502	04967	34469	7
54	65556	95027	70529	29471	04973	34444	6
55	65580	95020	70560	29440	04980	34419	5
56	65605	95014	70592	29408	04986	34395	4
57	65630	95007	70623	29377	04993	34370	3
58	65655	95001	70654	29346	04999	34345	2
59	65680	94994	70685	29315	05005	34320	1
60	65705	94988	70717	29283	05012	34295	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 27 Degrees.

M.	Sine.	Co-fine.	Tangen	Co-tang.	Secant.	Co-secan.	
0	9.65705	9.94988	9.70717	10.29283	10.05012	10.34295	60
1	65729	94982	70748	29252	05018	34270	59
2	65754	94975	70779	29221	05025	34246	58
3	65779	94969	70810	29190	05031	34221	57
4	65804	94962	70841	29159	05038	34196	56
5	65828	94956	70873	29127	05044	34172	55
6	65853	94949	70904	29096	05051	34147	54
7	65878	94943	70935	29065	05057	34122	53
8	65902	94936	70966	29034	05064	34097	52
9	65927	94930	70997	29003	05070	34073	51
10	9.65952	9.94923	9.71028	10.28972	10.05076	10.34048	50
11	65976	94917	71059	28941	05083	34024	49
12	66001	94910	71090	28910	05089	33999	48
13	66025	94904	71121	28878	05096	33974	47
14	66050	94897	71152	28847	05102	33950	46
15	66075	94891	71184	28816	05109	33925	45
16	66099	94884	71215	28785	05115	33901	44
17	66124	94878	71246	28754	05122	33876	43
18	66148	94871	71277	28723	05128	33852	42
19	66173	94865	71308	28692	05135	33827	41
20	9.66197	9.94858	9.71339	10.28661	10.05142	10.33803	40
21	66221	94852	71370	28730	05148	33779	39
22	66246	94845	71400	28699	05155	33754	38
23	66270	94839	71431	28668	05161	33730	37
24	66295	94832	71462	28638	05168	33705	36
25	66319	94826	71493	28607	05174	33681	35
26	66343	94819	71524	28576	05181	33657	34
27	66368	94813	71555	28545	05187	33632	33
28	66392	94806	71586	28514	05194	33608	32
29	66416	94799	71617	28483	05200	33584	31
30	9.66441	9.94793	9.71648	10.28352	10.05207	10.33559	30
31	66465	94786	71678	28321	05214	33535	29
32	66489	94780	71709	28291	05220	33511	28
33	66513	94773	71740	28260	05227	33487	27
34	66537	94766	71771	28229	05233	33462	26
35	66562	94760	71802	28198	05240	33438	25
36	66586	94753	71832	28167	05247	33414	24
37	66610	94747	71863	28137	05253	33390	23
38	66634	94740	71894	28106	05260	33366	22
39	66658	94733	71925	28075	05266	33342	21
40	9.66682	9.94727	9.71955	10.28044	10.05273	10.33318	20
41	66706	94720	71986	28014	05280	33293	19
42	66730	94714	72017	27983	05286	33269	18
43	66755	94707	72048	27952	05293	33245	17
44	66779	94700	72078	27922	05300	33221	16
45	66803	94694	72109	27891	05306	33197	15
46	66827	94687	72140	27860	05313	33173	14
47	66851	94680	72170	27830	05320	33149	13
48	66875	94674	72201	27799	05326	33125	12
49	66898	94667	72231	27768	05333	33101	11
50	9.66922	9.94660	9.72262	10.27738	10.05340	10.33077	10
51	66946	94654	72293	27707	05346	33054	9
52	66970	94647	72323	27678	05353	33030	8
53	66994	94640	72354	27646	05360	33006	7
54	67018	94634	72384	27616	05366	32982	6
55	67042	94627	72415	27585	05373	32958	5
56	67066	94620	72445	27555	05380	32934	4
57	67090	94614	72476	27524	05386	32910	3
58	67113	94607	72506	27493	05393	32887	2
59	67137	94600	72537	27463	05400	32863	1
60	67161	94593	72567	27433	05406	32839	0
Co-fine.	Sine.	Co-tang.	Tangent.	Co-secan.	Secant.	M.	

A Table of Artificial Sines, Tang. and Sec. 28 Degrees.

vi.	Sine.	Co-sine.	Tang.	Co-tang.	Secant.	Co-secan.	
0	9.67161	9.94593	9.72597	10.27433	10.05406	10.32839	60
1	67185	94587	72598	27492	05413	32815	59
2	67208	94580	72628	27372	05420	32792	58
3	67232	94573	72659	27341	05427	32768	57
4	67256	94567	72689	27311	05433	32744	56
5	67279	94560	72720	27280	05440	32720	55
6	67307	94553	72750	27250	05447	32697	54
7	67327	94546	72780	27219	05454	32673	53
8	67350	94540	72811	27189	05460	32648	52
9	67374	94533	72841	27159	05467	32625	51
10	9.67398	9.94526	9.72872	10.27128	10.05474	10.32602	50
11	67421	94519	72912	27098	05481	32579	49
12	67445	94512	72932	27068	05487	32555	48
13	67468	94506	72963	27037	05494	32532	47
14	67492	94499	72993	27007	05501	32508	46
15	67515	94492	73023	26977	05508	32484	45
16	67539	94485	73053	26946	05515	32461	44
17	67562	94479	73085	26916	05521	32438	43
18	67585	94472	73114	26886	05528	32414	42
19	67609	94465	73144	26856	05535	32391	41
20	9.67633	9.94458	9.73175	10.26825	10.05542	10.32367	40
21	67656	94451	73205	26795	05549	32344	39
22	67680	94445	73235	26765	05555	32320	38
23	67703	94438	73265	26735	05562	32297	37
24	67726	94431	73295	26704	05569	32274	36
25	67750	94424	73326	26674	05576	32250	35
26	67773	94417	73356	26644	05583	32227	34
27	67796	94410	73386	26614	05590	32204	33
28	67820	94404	73416	26584	05596	32180	32
29	67843	94397	73446	26554	05603	32157	31
30	9.67866	9.94390	9.73476	10.26524	10.05610	10.32134	30
31	67899	94383	73507	26493	05617	32110	29
32	67913	94376	73537	26463	05624	32087	28
33	67936	94369	73567	26433	05631	32064	27
34	67959	94362	73597	26403	05638	32041	26
35	67982	94355	73627	26373	05644	32018	25
36	68006	94349	73657	26343	05651	31994	24
37	68029	94342	73687	26313	05658	31971	23
38	68050	94335	73717	26283	05665	31948	22
39	68075	94328	73747	26253	05672	31925	21
40	9.68098	9.94321	9.73777	10.26223	10.05679	10.31902	20
41	68121	94314	73817	26193	05686	31879	19
42	68144	94307	73837	26163	05693	31856	18
43	68167	94300	73867	26133	05700	31832	17
44	68190	94293	73897	26103	05707	31809	16
45	68213	94286	73927	26073	05714	31786	15
46	68236	94279	73957	26043	05720	31763	14
47	68259	94272	73987	26013	05727	31740	13
48	68282	94266	74017	25983	05734	31717	12
49	68305	94259	74047	25953	05741	31694	11
50	9.68328	9.94252	9.74077	10.25923	10.05748	10.31672	10
51	68351	94245	74107	25893	05755	31649	9
52	68374	94238	74136	25863	05762	31626	8
53	68397	94231	74266	25834	05769	31602	7
54	68420	94224	74196	25803	05776	31580	6
55	68443	94217	74226	25774	05783	31556	5
56	68466	94210	74256	25744	05790	31534	4
57	68489	94203	74286	25714	05797	31511	3
58	68511	94196	74316	25684	05804	31488	2
59	68534	94189	74345	25655	05811	31466	1
60	68557	94182	74375	25625	05818	31443	0
Co-sine.	Sine.	Co-tang.	Tangent.	Co-secan.	Secant.	M.	

A Table of Artificial Sines, Tang. and Sec. 29 Degrees.

M.	Sine.	Co-sine.	Tang.	Co-tang.	Secant.	Co-secan.	
0	9.68537	9.94182	9.74375	10.25625	10.05818	10.31443	60
1	68580	94175	74405	25595	05825	31420	59
2	68603	94168	74435	25565	05832	31397	58
3	68625	94161	74464	25535	05839	31375	57
4	68648	94154	74494	25506	05846	31352	56
5	68671	94147	74524	25476	05853	31329	55
6	68694	94140	74554	25446	05860	31306	54
7	68716	94133	74583	25416	05867	31284	53
8	68739	94126	74613	25387	05874	31261	52
9	68762	94119	74643	25357	05881	31238	51
10	9.68784	9.94112	9.74673	10.25327	10.05888	10.31216	50
11	68807	94105	74702	25298	05895	31193	49
12	68829	94097	74732	25268	05902	31170	48
13	68852	94090	74762	25238	05909	31148	47
14	68875	94083	74791	25209	05917	31125	46
15	68897	94076	74821	25179	05924	31103	45
16	68920	94069	74850	25149	05931	31080	44
17	68942	94062	74880	25120	05938	31058	43
18	68965	94055	74910	25090	05945	31035	42
19	68987	94048	74939	25061	05942	31013	41
20	9.69010	9.94041	9.74969	10.25031	10.05959	10.30990	40
21	69032	94034	74990	25001	05966	30968	39
22	69055	94027	75028	24972	05973	30945	38
23	69077	94020	75058	24942	05980	30923	37
24	69100	94012	75087	24913	05987	30900	36
25	69122	94005	75117	24883	05995	30878	35
26	69144	93998	75146	24854	06002	30856	34
27	69167	93991	75176	24824	06009	30833	33
28	69189	93984	75205	24795	06016	30811	32
29	69211	93977	75235	24765	06025	30788	31
30	9.69234	9.93970	9.75264	10.24736	10.06030	10.30766	30
31	69256	93962	75294	24706	06037	30744	29
32	69278	93955	75323	24677	06045	30721	28
33	69301	93948	75353	24647	06052	30699	27
34	69323	93941	75382	24618	06059	30677	26
35	69345	93934	75411	24588	06066	30655	25
36	69368	93927	75441	24559	06073	30632	24
37	69390	93919	75470	24530	06080	30610	23
38	69412	93912	75500	24500	06088	30588	22
39	69434	93905	75529	24471	06095	30566	21
40	9.69456	9.93898	9.75558	10.24441	10.06102	10.30544	20
41	69479	93891	75588	24412	06109	30521	19
42	69501	93884	75617	24383	06116	30499	18
43	69523	93876	75646	24353	06124	30477	17
44	69545	93869	75676	24324	06131	30455	16
45	69567	93862	75705	24295	06138	30433	15
46	69589	93855	75734	24265	06145	30411	14
47	69611	93847	75764	24236	06152	30389	13
48	69633	93840	75793	24207	06160	30367	12
49	69655	93833	75822	24178	06167	30345	11
50	9.69677	9.93826	9.75852	10.24148	10.06174	10.30323	10
51	69699	93818	75881	24119	06181	30300	9
52	69721	93811	75910	24090	06189	30278	8
53	69743	93804	75939	24060	06196	30256	7
54	69765	93797	75969	24031	06203	30235	6
55	69787	93789	75998	24002	06210	30213	5
56	69809	93782	76027	23973	06218	30191	4
57	69831	93775	76056	23944	06225	30169	3
58	69853	93768	76086	23914	06232	30147	2
59	69875	93760	76115	23885	06240	30125	1
60	69897	93753	76144	23856	06247	30103	0
	Co-line.	Sine.	Co-tang.	Tangent.	Co-secan.	Secant.	M.

[0 2]

60 Degrees.

A Table of Artificial Sines, Tang. and Sec. 30 Degrees.

M.	Sine	Co-sine	Tangen.	Co-ang.	Secant.	Co-secant.	
0	9.69397	9.93753	9.76144	10.23856	10.06247	10.30103	60
1	69919	93745	76173	23827	06254	30081	59
2	69941	93738	76202	23798	06261	30059	58
3	69963	93731	76231	23769	06269	30037	57
4	69984	93724	76261	23739	06276	30016	56
5	70006	93716	76290	23710	06283	29994	55
6	70028	93709	76319	23681	06291	29972	54
7	70050	93702	76348	23652	06298	29950	53
8	70072	93695	76377	23623	06305	29928	52
9	70094	93687	76406	23594	06313	29907	51
10	9.70115	9.93580	9.70435	10.23565	10.06320	10.29885	50
11	70137	93672	76464	23536	06327	29864	49
12	70158	93665	76493	23507	06335	29841	48
13	70180	93658	76522	23478	06342	29820	47
14	70202	93650	76551	23449	06349	29798	46
15	70224	93643	76580	23419	06357	29776	45
16	70245	93636	76609	23390	06364	29755	44
17	70267	93628	76638	23361	06372	29733	43
18	70288	93621	76667	23332	06379	29711	42
19	70310	93614	76696	23303	06386	29690	41
20	9.70332	9.93606	9.76725	10.23274	10.06394	10.29668	40
21	70353	93599	76754	23245	06401	29647	39
22	70375	93591	76783	23217	06409	29625	38
23	70396	93584	76812	23188	06416	29604	37
24	70418	93577	76841	23159	06423	29582	36
25	70439	93569	76870	23130	06431	29560	35
26	70461	93562	76899	23101	06438	29539	34
27	70482	93554	76928	23072	06446	29517	33
28	70504	93547	76957	23043	06453	29496	32
29	70525	93539	76986	13014	06460	29475	31
30	9.70547	9.93532	9.77015	10.22985	10.06468	10.29453	30
31	70568	93525	77044	22959	06475	29432	29
32	70590	93517	77073	22927	06483	29410	28
33	70611	93510	77101	22927	06490	29389	27
34	70633	93502	77130	22898	06498	29367	26
35	70654	93495	77159	22870	06505	29346	25
36	70675	93487	77188	22841	06513	29325	24
37	70697	93480	77217	22812	06520	29303	23
38	70718	93472	77246	22783	06528	29282	22
39	70739	93465	77274	22725	06535	29261	21
40	9.70761	9.93457	9.77303	10.22697	10.06543	10.29233	20
41	70782	93450	77332	22668	06550	29218	19
42	70803	93442	77361	22639	06558	29197	18
43	70824	93435	77390	22610	06565	29175	17
44	70846	93427	77418	22582	06573	29154	16
45	70867	93420	77447	22553	06580	29133	15
46	70888	93412	77476	22524	06588	29112	14
47	70909	93405	77505	22495	06595	29091	13
48	70931	93397	77533	22467	06603	29069	12
49	70952	93390	77562	22438	06610	29048	11
50	9.70973	9.93382	9.77591	10.22409	10.06618	10.29027	10
51	70994	93375	77619	22380	06625	29006	9
52	71015	93367	77648	22352	06633	28985	8
53	71036	93360	77677	22323	06640	28964	7
54	71057	93352	77705	22294	06648	28942	6
55	71079	93344	77734	22266	06656	28921	5
56	71100	93337	77763	22237	06663	28900	4
57	71121	93329	77791	22208	06671	28879	3
58	71142	93322	77820	22180	06678	28858	2
59	71164	93314	77849	22151	06686	28837	1
60	71185	93307	77877	22123	06693	28816	0
	Co-tang.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 31 Degrees.

M.	Sine.	Co-fine.	Tang.	Co-tang.	Secant.	Co-secan.	
0	9.71184	9.93307	9.77877	10.22123	10.06693	10.28816	60
1	71205	93299	77906	22094	06701	28795	59
2	71226	93291	77935	22065	06709	28774	58
3	71247	93284	77963	22037	06716	28753	57
4	71268	93276	77992	22008	06724	28732	56
5	71289	93268	78021	21980	06731	28711	55
6	71310	93261	78049	21951	06739	28690	54
7	71331	93253	78077	21922	06747	28669	53
8	71352	93246	78106	21894	06754	28648	52
9	71373	93238	78135	21865	06762	28627	51
10	9.71393	9.93230	9.78163	10.21837	10.06770	10.28606	50
11	71414	93223	78192	21808	06777	28586	49
12	71435	93215	78220	21780	06785	28565	48
13	71456	93207	78249	21751	06792	28544	47
14	71477	93200	78277	21723	06800	28523	46
15	71498	93192	78306	21694	06808	28502	45
16	71515	93184	78334	21666	06815	28481	44
17	71539	93177	78363	21637	06823	28461	43
18	71560	93169	78391	21609	06831	28440	42
19	71581	93161	78419	21580	06834	28419	41
20	9.71602	9.93154	9.78448	10.21552	10.06846	10.28398	40
21	71622	93146	78476	21524	06854	28378	39
22	71643	93138	78505	21495	06862	28358	38
23	71663	93131	78533	21467	06869	28336	37
24	71685	93123	78562	21438	06877	28315	36
25	71705	93115	78590	21410	06885	28295	35
26	71726	93107	78618	21382	06892	28274	34
27	71747	93100	78647	21353	06900	28253	33
28	71767	93092	78675	21325	06908	28233	32
29	71788	93084	78704	21296	06916	28212	31
30	9.71808	9.93077	9.78732	10.21268	10.06923	10.28191	30
31	71829	93069	78760	21240	06931	28171	29
32	71850	93061	78789	21211	06939	28150	28
33	71870	93053	78817	21183	06947	28130	27
34	71891	93046	78845	21155	06954	28119	26
35	71911	93038	78874	21126	06962	28089	25
36	71932	93030	78902	21098	06970	28068	24
37	71952	93022	78930	21070	06978	28048	23
38	71973	93014	78958	21041	06985	28027	22
39	71993	93007	78987	21013	06993	28006	21
40	9.72014	9.92999	9.79015	10.20985	10.07001	10.27986	20
41	72034	92991	79043	20957	07009	27965	19
42	72055	92983	79072	20928	07017	27945	18
43	72075	92975	79100	20900	07024	27925	17
44	72096	92968	79128	20872	07032	27904	16
45	72116	92960	79156	20844	07040	27884	15
46	72137	92952	79185	20815	07048	27863	14
47	72157	92944	79213	20787	07056	27843	13
48	72177	92936	79241	20759	07064	27823	12
49	72198	92929	79269	20731	07071	27802	11
50	9.72218	9.92921	9.79297	10.20703	10.07079	10.27782	10
51	72238	92913	79326	20674	07087	27761	9
52	72259	92905	79354	20646	07095	27741	8
53	72279	92897	79382	20618	07103	27721	7
54	72299	92889	79410	20590	07111	27701	6
55	72320	92881	79438	20562	07119	27680	5
56	72340	92874	79466	20534	07126	27660	4
57	72360	92866	79494	20505	07134	27640	3
58	72380	92858	79523	20477	07142	27619	2
59	72401	92850	79551	20449	07150	27599	1
60	72421	92842	79579	20421	07158	27579	0
	Co-fine.	Sine.	Co tang.	Tangent.	Co-secan.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 32 Degrees.

M.	Sine.	Co-sine.	Tang.	Co tang.	Secant.	Co-secan.	
0	9.72721	9.92842	9.79579	10.20421	10.07153	10.27579	62
1	72441	92834	79607	20393	07166	27559	59
2	72461	92825	79635	20365	07174	27539	58
3	72482	92818	79663	20337	07182	27518	57
4	72502	92810	79691	20309	07190	27498	56
5	72522	92802	79719	20281	07197	27478	55
6	72542	92795	79747	20252	07205	27458	54
7	72562	92787	79775	20224	07213	27438	53
8	72582	92779	79804	20196	07221	27418	52
9	72602	92770	79832	20168	07229	27398	51
10	9.72622	9.92763	9.79863	10.20140	10.07237	10.27377	50
11	72642	92755	79888	20112	07245	27357	49
12	72663	92747	79916	20084	07253	27337	48
13	72683	92739	79944	20056	07261	27317	47
14	72703	92731	79972	20028	07269	27297	46
15	72723	92723	80000	20003	07277	27277	45
16	72743	92715	80028	19972	07285	27257	44
17	72763	92707	80056	19944	07293	27237	43
18	72783	92699	80084	19916	07301	27217	42
19	72803	92691	80112	19888	07309	27197	41
20	9.72823	9.92683	9.80140	10.19860	10.07317	10.27177	40
21	72843	92675	80167	19832	07325	27157	39
22	72863	92667	80195	19804	07333	27137	38
23	72882	92659	80223	19777	07341	27117	37
24	72902	92651	80251	19749	07349	27098	36
25	72922	92643	80279	19721	07357	27078	35
26	72942	92635	80307	19693	07365	27058	34
27	72962	92627	80335	19665	07373	27038	33
28	72982	92619	80363	19637	07381	27018	32
29	73002	92611	80391	19609	07389	26998	31
30	9.73022	9.92603	9.80419	10.19581	10.07397	10.26978	30
31	73041	92595	80447	19553	07405	26958	29
32	73061	92586	80474	19525	07413	26938	28
33	73081	92579	80502	19498	07421	26919	27
34	73101	92571	80530	19470	07429	26899	26
35	73121	92563	80558	19442	07437	26879	25
36	73140	92554	80581	19414	07445	26859	24
37	73160	92546	80614	19386	07453	26840	23
38	73180	92538	80641	19358	07462	26820	22
39	73200	92530	80669	19331	07470	26800	21
40	9.73219	9.92522	9.80697	10.19303	10.07478	10.26781	20
41	73239	92514	80725	19275	07486	26761	19
42	73259	92506	80753	19247	07494	26741	18
43	73278	92498	80780	19219	07502	26722	17
44	73298	92490	80808	19192	07510	26702	16
45	73318	92482	80836	19164	07518	26682	15
46	73337	92473	80864	19136	07526	26663	14
47	73357	92465	80892	19108	07535	26643	13
48	73376	92457	80919	19081	07543	26623	12
49	73396	92449	80947	19053	07551	26604	11
50	9.73416	9.92441	9.80975	10.19025	10.07559	10.26584	10
51	73435	92433	81002	18997	07567	26565	9
52	73455	92425	81030	18970	07575	26545	8
53	73474	92416	81058	18942	07584	26526	7
54	73494	92408	81086	18914	07592	26506	6
55	73513	92400	81113	18887	07600	26486	5
56	73533	92392	81141	18859	07608	26467	4
57	73552	92384	81169	18831	07616	26447	3
58	73572	92375	81196	18804	07624	26428	2
59	73591	92367	81224	18775	07633	26409	1
60	73611	92359	81222	18748	07641	26389	0
	Co sine.	Sine.	Co-tang.	Tangent.	Co-secan.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 33 Degrees.

M.	Sine.	Co-sine.	Tang.	Co-tang.	Secant.	Co-secan.	
0	9.73611	9.92359	9.81252	10.18748	10.07640	10.26389	60
1	73630	92351	81279	18721	07649	26370	59
2	73650	92343	81307	18693	07657	26350	58
3	73669	92334	81336	18665	07665	26331	57
4	73689	92326	81362	18638	07674	26311	56
5	73708	92318	81390	18610	07682	26292	55
6	73727	92310	81417	18582	07690	26273	54
7	73747	92302	81445	18555	07698	26253	53
8	73766	92293	81473	18527	07707	26234	52
9	73785	92285	81500	18500	07715	26214	51
10	9.73805	9.92277	9.81528	10.18472	10.07725	10.26195	50
11	73824	92269	81555	18444	07731	26176	49
12	73843	92260	81582	18417	07740	26157	48
13	73863	92252	81611	18389	07748	26137	47
14	73882	92244	81638	18362	07756	26118	46
15	73901	92235	81666	18334	07764	26099	45
16	73920	92227	81693	18307	07773	26079	44
17	73940	92219	81721	18279	07781	26060	43
18	73959	92211	81748	18252	07789	26041	42
19	73978	92202	81776	18224	07798	26022	41
20	9.73997	9.92194	9.81803	10.18196	10.07806	10.26002	40
21	74017	92186	81831	18169	07814	25983	39
22	74036	92177	81858	18141	07823	25964	38
23	74055	92169	81886	18114	07831	25945	37
24	74074	92161	81913	18086	07839	25926	36
25	74093	92152	81941	18059	07848	25907	35
26	74112	92144	81968	18032	07856	25887	34
27	74132	92136	81996	18004	07864	25868	33
28	74151	92127	82023	17977	07878	25849	32
29	74170	92119	82051	17949	07881	25830	31
30	9.74189	9.92111	9.82078	10.17922	10.07889	10.25811	30
31	74208	92102	82109	17894	07878	25792	29
32	74227	92094	82133	17867	07906	25773	28
33	74246	92085	82161	17839	07914	25754	27
34	74265	92077	82188	17812	07923	25735	26
35	74284	92069	82215	17784	07931	25716	25
36	74303	92060	82243	17757	07940	25697	24
37	74322	92052	82270	17730	07948	25678	23
38	74341	92044	82298	17702	07956	25659	22
39	74360	92335	82325	17675	07965	25640	21
40	9.74379	9.92102	9.82352	10.17648	10.07973	10.25621	20
41	74398	92018	82380	17620	07982	25602	19
42	74417	92010	82407	17593	07990	25583	18
43	74436	92001	82434	17565	07998	25564	17
44	74455	91993	82462	17538	08007	25545	16
45	74475	91985	82489	17511	08015	25526	15
46	74494	91976	82517	17483	08024	25507	14
47	74512	91968	82544	17456	08032	25488	13
48	74532	91959	82571	17429	08041	25469	12
49	74549	91951	82599	17401	08049	25451	11
50	9.74568	9.91942	9.82620	10.17374	10.08058	10.25432	10
51	74587	91934	82653	17347	08066	25413	9
52	74606	91925	82680	17319	08075	25394	8
53	74625	91917	82708	17292	08083	25375	7
54	74644	91908	82735	17265	08091	25356	6
55	74662	91900	82762	17238	08100	25338	5
56	74681	91891	82790	17210	08108	25319	4
57	74700	91883	82817	17183	08117	25300	3
58	74719	91874	82844	17156	08125	25281	2
59	74737	91866	82871	17128	08134	25263	1
60	74756	91857	82899	17101	08143	25244	0
Co-Sine.	Sine.	Co-tang.	Tangent.	Co-secan.	Secant.	M.	

A Table of Artificial Sines, Tang. and Sec. 34 Degrees.

M.	Sine.	Co. sine.	Tang.	C. Tang.	Secant.	Co. Secant.	
0	9.74756	9.91857	9.82847	10.17101	10.08143	10.25244	00
1	74775	91849	82926	17074	08151	25225	59
2	74794	91840	82953	17047	08160	25206	58
3	74812	91832	82980	17019	08168	25188	57
4	74831	91823	83008	16992	08177	25169	56
5	74850	91815	83035	16965	08185	25150	55
6	74868	91806	83062	16938	08194	25132	54
7	74887	91798	83089	16911	08202	25113	53
8	74906	91789	83116	16883	08211	25094	52
9	74924	91780	83144	16856	08219	25076	51
10	9.74943	9.91772	9.83171	10.16849	10.08228	10.25057	50
11	74961	91763	83198	16802	08237	25038	49
12	74980	91755	83225	16775	08245	25020	48
13	74999	91746	83252	16747	08254	25001	47
14	75017	91738	83279	16720	08262	24983	46
15	75036	91729	83307	16693	08271	24964	45
16	75054	91720	83334	16666	08280	24946	44
17	75072	91712	83361	16639	08288	24927	43
18	75091	91703	83388	16612	08297	24909	42
19	75110	91694	83415	16585	08305	24890	41
20	9.75128	9.91686	9.83442	10.16557	10.08314	10.24872	40
21	75147	91677	83470	16530	08323	24853	39
22	75165	91668	83497	16503	08331	24835	38
23	75184	91660	83524	16476	08340	24816	37
24	75202	91651	83551	16449	08349	24798	36
25	75221	91643	83578	16422	08357	24779	35
26	75239	91634	83605	16394	08366	24761	34
27	75258	91625	83632	16368	08375	24742	33
28	75276	91617	83659	16341	08383	24724	32
29	75294	91608	83686	16314	08392	24706	31
30	9.75313	9.91599	9.83713	10.16287	10.08401	10.24687	30
31	75331	91591	83740	16259	08409	24669	29
32	75349	91582	83767	16232	08418	24650	28
33	75368	91573	83795	16205	08427	24632	27
34	75386	91565	83822	16178	08435	24614	26
35	75405	91556	83840	16151	08444	24595	25
36	75423	91547	83876	16124	08453	24577	24
37	75441	91538	83903	16097	08461	24559	23
38	75459	91530	83930	16070	08470	24540	22
39	75478	91521	83957	16043	08479	24522	21
40	9.75496	9.91512	9.83984	10.16016	10.08488	10.24504	20
41	75514	91503	84011	15989	08496	24486	19
42	75533	91495	84038	15962	08505	24467	18
43	75551	91486	84065	15935	08514	24449	17
44	75569	91477	84092	15908	08523	24431	16
45	75587	91468	84119	15881	08531	24413	15
46	75605	91460	84146	15854	08540	24395	14
47	75624	91451	84173	15827	08549	24376	13
48	75642	91442	84200	15800	08558	24358	12
49	75660	91433	84227	15773	08567	24340	11
50	9.75678	9.91425	9.84254	10.15746	10.08575	10.24322	10
51	75696	91416	84280	15719	08584	24304	9
52	75714	91407	84307	15693	08593	24286	8
53	75732	91398	84334	15666	08602	24267	7
54	75751	91389	84361	15639	08611	24249	6
55	75769	91381	84388	15612	08619	24231	5
56	75787	91372	84415	15585	08628	24213	4
57	75805	91363	84442	15558	08637	24195	3
58	75823	91354	84469	15531	08646	24177	2
59	75841	91345	84496	15504	08655	24159	1
60	75859	91336	84523	15477	08664	24141	0
Co. sine.	Sine.	Co. ang.	Tangent.	Co. fecan.	Secant.	M.	

A Table of Artificial Sines, Tang. and Sec. 35 Degrees.

M.	Sine.	Co-sine.	Tang.	Co-tang.	Secant.	Co-secan.	
0	9-75859	9-91336	9-84523	10-15477	10-08664	10-24141	60
1	75877	91328	84550	15450	08672	24123	59
2	75895	91319	84516	15424	08681	24105	58
3	75913	91313	84603	15397	08690	24087	57
4	75931	91301	84630	15373	08699	24069	56
5	75949	91292	84657	15343	08708	24051	55
6	75967	91283	84684	15316	08717	24033	54
7	75985	91274	84711	15289	08726	24015	53
8	76003	91265	84738	15262	08734	23997	52
9	76021	91257	84764	15236	08743	23979	51
10	9-76039	9-91248	9-84791	10-15209	10-08752	10-23961	50
11	76057	91239	84818	15182	08761	23943	49
12	76075	91230	84845	15155	08770	23925	48
13	76093	91221	84872	15128	08779	23907	47
14	76111	91212	84898	15101	08788	23886	46
15	76128	91203	84925	15075	08797	23871	45
16	76146	91194	84952	15048	08806	23854	44
17	76164	91185	84979	15021	08815	23836	43
18	76182	91176	85006	14994	08824	23818	42
19	76200	91167	85032	14967	08833	23800	41
20	9-76218	9-91158	9-85059	10-14941	10-08842	10-23782	40
21	76236	91149	85086	14914	08850	23764	39
22	76253	91140	85113	14887	08859	23747	38
23	76271	91131	85140	14860	08868	23729	37
24	76289	91123	85166	14834	08877	23711	36
25	76307	91114	85193	14807	08886	23693	35
26	76324	91105	85220	14780	08895	23675	34
27	76342	91096	85247	14753	08904	23658	33
28	76360	91087	85273	14727	08913	23640	32
29	76378	91078	85300	14700	08922	23622	31
30	9-76395	9-91069	9-85327	10-14673	10-08931	10-23605	30
31	76413	91060	85353	14646	08940	23587	29
32	76431	91051	85380	14620	08949	23569	28
33	76448	91042	85407	14593	08958	23551	27
34	76466	91032	85434	14566	08967	23534	26
35	76485	91023	85460	14540	08976	23516	25
36	76501	91014	85487	14513	08987	23498	24
37	76519	91005	85514	14486	08995	23481	23
38	76537	90996	85540	14460	09004	23463	22
39	76554	90987	85567	14433	09013	23446	21
40	9-76572	9-90978	9-85594	10-14406	10-09022	10-23428	20
41	76590	90969	85620	14380	09031	23410	19
42	76607	90960	85647	14353	09040	23393	18
43	76625	90951	85674	14326	09049	23375	17
44	76642	90942	85700	14300	09058	23358	16
45	76660	90933	85727	14273	09067	23340	15
46	76677	90924	85754	14246	09076	23323	14
47	76695	90915	85780	14220	09085	23305	13
48	76762	90905	85807	14193	09094	23288	12
49	76730	90896	85834	14166	09094	23270	11
50	9-76747	9-90887	9-85860	10-14140	10-09113	10-23252	10
51	76765	90878	85887	14113	09122	23235	9
52	76782	90869	85913	14087	09131	23218	8
53	76800	90860	85940	14060	09140	23200	7
54	76817	90851	85967	14033	09149	23183	6
55	76835	90842	85993	14006	09158	23166	5
56	76852	90832	86020	13980	09168	23148	4
57	76870	90823	86046	13954	09177	23130	3
58	76887	90814	86073	13927	09186	23113	2
59	76904	90805	86099	13900	09194	23095	1
60	76922	90797	86126	13874	09204	23078	0
Co-sine.	Sine.	Co-tang.	Tangent.	Co-secan.	Secant.	M.	

A Table of Artificial Sines, Tang. and Sec. 36 Degrees.

M.	Sine.	Co-sine.	Tangen.	Co-tang.	Secant.	Co-secan.	
0	9.76922	9.90796	9.86126	10.13874	10.09204	10.23078	60
1	76939	90787	86153	13847	09213	23061	59
2	76957	90777	86179	13821	09223	23043	58
3	76974	90768	86206	13794	09232	23026	57
4	76991	90759	86232	13768	09241	23009	56
5	77009	90750	86259	13741	09250	22991	55
6	77026	90741	86285	13715	09259	22974	54
7	77043	90731	86312	13688	09269	22957	53
8	77061	90722	86338	13661	09278	22939	52
9	77078	90713	86365	13635	09287	22922	51
10	9.77095	9.90704	9.86391	10.13608	10.09296	10.22905	50
11	77112	90694	86418	13582	09306	22887	49
12	77130	90685	86444	13555	09315	22870	48
13	77147	90676	86471	13529	09324	22853	47
14	77164	90667	86497	13502	09333	22837	46
15	77181	90657	86524	13476	09343	22818	45
16	77199	90648	86550	13449	09352	22801	44
17	77216	90639	86577	13423	09361	22784	43
18	77233	90630	86603	13396	09370	22767	42
19	77250	90620	86630	13370	09380	22750	41
20	9.77267	9.90611	9.86656	10.13344	10.09389	10.22732	40
21	77285	90602	86683	13317	09398	22715	39
22	77302	90592	86706	13291	09407	22698	38
23	77319	90583	86736	13264	09417	22681	37
24	77336	90574	86762	13238	09426	22664	36
25	77353	90564	86789	13211	09435	22647	35
26	77370	90555	86815	13185	09445	22630	34
27	77387	90546	86842	13158	09454	22612	33
28	77405	90537	86868	13132	09463	22595	32
29	77422	90527	86894	13105	09473	22578	31
30	9.77439	9.90518	9.86921	10.13079	10.09482	10.22561	30
31	77456	90508	86947	13053	09491	22544	29
32	77473	90499	86974	13026	09501	22527	28
33	77490	90490	87000	13000	09510	22510	27
34	77507	90480	87022	12972	09520	22493	26
35	77524	90471	87053	12947	09529	22476	25
36	77541	90462	87079	12921	09538	22459	24
37	77558	90453	87106	12894	09548	22442	23
38	77575	90443	87132	12868	09557	22425	22
39	77592	90433	87158	12841	09566	22408	21
40	9.77609	9.90424	9.87185	10.12815	10.09576	10.22391	20
41	77626	90415	87211	12789	09585	22374	19
42	77643	90405	87238	12762	09595	22357	18
43	77660	90396	87264	12736	09604	22340	17
44	77677	90386	87290	12710	09613	22323	16
45	77694	90377	87317	12683	09623	22306	15
46	77711	90368	87343	12657	09632	22289	14
47	77727	90358	87369	12631	09642	22272	13
48	77744	90349	87396	12604	09651	22256	12
49	77761	90339	87422	12578	09661	22239	11
50	9.77778	9.90330	9.87448	10.12551	10.09670	10.22222	10
51	77795	90320	87476	12525	09680	22205	9
52	77812	90311	87501	12499	09689	22188	8
53	77829	90301	87527	12473	09699	22171	7
54	77845	90292	87554	12446	09708	22154	6
55	77862	90282	87580	12420	09718	22138	5
56	77879	90273	87606	12394	09727	22121	4
57	77896	90263	87633	12367	09737	22104	3
58	77913	90254	87659	12341	09746	22087	2
59	77929	90244	87685	12315	09756	22070	1
60	77946	90235	87711	12289	09765	22054	0
Co sine.	Sine.	Co tang.	Tangent.	Co-secan.	Secant.	M.	

A Table of Artificial Sines, Tang. and Sec. 37 Degrees.

mi.	Sine.	Co-sine.	Tang.	Co-tang.	Secant.	Co-secan.	
0	9.77946	9.90235	9.87711	10.12289	10.09765	10.22054	60
1	77963	90225	87738	12262	09775	22037	59
2	77980	90216	87764	12236	09784	22020	58
3	77906	90206	87790	12210	09794	22003	57
4	78013	90197	87816	12183	09803	21987	56
5	78030	90187	87843	12157	09813	21970	55
6	78047	90178	87869	12131	09822	21953	54
7	78063	90168	87895	12105	09832	21937	53
8	78080	90158	87921	12078	09841	21920	52
9	78097	90149	87948	12052	09851	21903	51
10	9.78113	9.90139	9.87974	10.12026	10.09861	10.21887	50
11	78130	90130	88000	12000	09870	21870	49
12	78147	90120	88026	11973	09880	21853	48
13	78163	90111	88053	11947	09889	21837	47
14	78180	90101	88080	11921	09899	21820	46
15	78197	90091	88105	11895	09909	21803	45
16	78213	90082	88131	11869	09918	21787	44
17	78230	90072	88158	11842	09928	21770	43
18	78246	90063	88184	11816	09937	21754	42
19	78263	90053	88210	11790	09947	21737	41
20	9.78280	9.90043	9.88236	10.11764	10.09957	10.21720	40
21	78296	90034	88262	11737	09966	21704	39
22	78313	90024	88289	11711	09976	21687	38
23	78329	90014	88315	11685	09986	21671	37
24	78346	90005	88341	11659	09995	21654	36
25	78362	89995	88367	11633	10005	21638	35
26	78370	89985	88393	11607	10015	21621	34
27	78395	89976	88420	11580	10024	21605	33
28	78412	89966	88446	11554	10034	21588	32
29	78428	89956	88472	11528	10044	21572	31
30	9.78445	9.89947	9.88498	10.11502	10.10053	10.21555	30
31	78461	89937	88524	11476	10063	21539	29
32	78478	89927	88550	11450	10073	21522	28
33	78494	89918	88576	11423	10082	21506	27
34	78510	89908	88603	11397	10092	21489	26
35	78527	89898	88629	11371	10102	21473	25
36	78543	89888	88655	11345	10112	21457	24
37	78560	89879	88681	11319	10121	21440	23
38	78576	89869	88707	11293	10131	21424	22
39	78592	89859	88733	11267	10141	21407	21
40	9.78609	9.89849	9.88759	10.11241	10.10151	10.21391	20
41	78625	89840	88785	11214	10160	21375	19
42	78642	89830	88812	11188	10170	21358	18
43	78658	89820	88838	11162	10180	21342	17
44	78674	89810	88864	11136	10190	21326	16
45	78691	89801	88890	11110	10199	21309	15
46	78707	89791	88916	11084	10209	21293	14
47	78723	89781	88942	11058	10219	21277	13
48	78739	89771	88968	11032	10229	21260	12
49	78756	89761	88994	11006	10239	21244	11
50	9.78772	9.89752	9.89020	10.10980	10.10248	10.21228	10
51	78788	89742	89046	10953	10258	21212	9
52	78804	89732	89072	10927	10268	21195	8
53	78821	89722	89099	10901	10278	21179	7
54	78837	89712	89125	10875	10288	21163	6
55	78853	89702	89151	10849	10297	21147	5
56	78869	89693	89177	10823	10307	21131	4
57	78886	89683	89203	10797	10317	21114	3
58	78902	89673	89229	10771	10327	21098	2
59	78918	89663	89255	10745	10337	21082	1
60	78934	89653	89281	10719	10347	21066	0
Co-sine.	Sine.	Co-tang.	Tangent.	Co-secan.	Secant.	M.	

A Table of Artificial Sines, Tang. and Sec. 38 Degrees.

M.	Sine.	Co-sine.	Tang.	Co tang.	Secant.	Co-secan.	
0	9.78934	9.89153	9.89261	10.10719	10.10347	10.21066	60
1	78950	89043	89357	10693	10357	21050	59
2	78966	89033	89333	10667	10366	21033	58
3	78983	89024	89359	10641	10376	21017	57
4	78999	89014	89385	10615	10386	21001	56
5	79015	89004	89411	10589	10396	20985	55
6	79031	89594	89437	10563	10406	20969	54
7	79047	89584	89463	10537	10416	20953	53
8	79063	89574	89489	10511	10426	20937	52
9	79079	89564	89515	10485	10432	20921	51
10	9.79095	9.89554	9.89541	10.10459	10.10446	10.20905	50
11	79111	89544	89567	10433	10456	20888	49
12	79127	89534	89593	10407	10466	20872	48
13	79144	89524	89619	10381	10476	20856	47
14	79160	89514	89645	10355	10486	20840	46
15	79176	89504	89671	10329	10495	20824	45
16	79192	89494	89697	10303	10505	20808	44
17	79208	89485	89723	10277	10515	20792	43
18	79224	89475	89749	10250	10525	20776	42
19	79240	89465	89775	10225	10535	20760	41
20	9.79256	9.89455	9.89801	10.10199	10.10545	10.20744	40
21	79272	89445	89827	10173	10555	20728	39
22	79288	89435	89853	10147	10565	20712	38
23	79303	89425	89879	10121	10575	20696	37
24	79319	89415	89905	10095	10585	20680	36
25	79335	89405	89931	10069	10595	20665	35
26	79351	89395	89957	10043	10605	20649	34
27	79367	89384	89983	10017	10615	20633	33
28	79383	89374	90005	99991	10625	20617	32
29	79399	89365	90035	99965	10635	20601	31
30	9.79415	9.89354	9.90060	10.09939	10.10646	10.20585	30
31	79431	89344	90086	99913	10656	20569	29
32	79447	89334	90112	99888	10666	20553	28
33	79463	89324	90138	99862	10676	20537	27
34	79478	89314	90164	99836	10686	20522	26
35	79494	89304	90190	99810	10696	20506	25
36	79510	89294	90216	99784	10706	20490	24
37	79526	89284	90242	99758	10716	20474	23
38	79542	89274	90268	99732	10726	20458	22
39	79557	89264	90294	99706	10736	20442	21
40	9.79573	9.89254	9.90320	10.09680	10.10746	10.20426	20
41	79589	89243	90345	99654	10756	20411	19
42	79605	89233	90371	99629	10767	20395	18
43	79621	89223	90397	99603	10777	20379	17
44	79636	89213	90423	99577	10787	20364	16
45	79652	89203	90449	99551	10797	20348	15
46	79668	89193	90475	99525	10807	20332	14
47	79684	89183	90501	99499	10817	20316	13
48	79699	89173	90527	99473	10827	20301	12
49	79715	89162	90553	99447	10837	20285	11
50	9.79731	9.89152	9.90578	10.09421	10.10848	10.20269	10
51	79746	89142	90604	99396	10858	20254	9
52	79762	89132	90630	99370	10868	20238	8
53	79778	89122	90656	99344	10878	20222	7
54	79793	89111	90682	99318	10889	20207	6
55	79809	89101	90708	99292	10899	20191	5
56	79825	89091	90734	99266	10909	20175	4
57	79840	89081	90759	99241	10919	20160	3
58	79856	89071	90785	99215	10929	20144	2
59	79872	89061	90811	99189	10939	20128	1
60	79887	89050	90837	99163	10950	20113	0
	Co-Sine.	Sine.	Co-tang.	Tangent.	Co-secan.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 39 Degrees.

M.	Sine.	Co-sine.	Tang.	Co tang.	Secant.	Co-secan.	
0	9.79887	9.89050	9.90837	10.09163	10.10950	10.20113	60
1	79903	89040	90863	09137	10960	20097	59
2	79918	89030	90889	09111	10970	20081	58
3	79934	89019	90914	09086	10980	20066	57
4	79949	89009	90940	09060	10991	20050	56
5	79965	88999	90966	09034	11001	20035	55
6	79981	88989	90992	09008	11011	20019	54
7	79996	88978	91018	08982	11021	20004	53
8	80012	88968	91043	08956	11032	19988	52
9	80027	88958	91069	08931	11042	19973	51
10	9.80043	9.88948	9.91095	10.08905	10.11052	10.19957	50
11	80058	88937	91121	08879	11063	19942	49
12	80074	88927	91147	08853	11073	19926	48
13	80089	88916	91172	08824	11083	19911	47
14	80105	88906	91198	08802	11094	19895	46
15	80120	88896	91224	08776	11104	19880	45
16	80136	88885	91250	08750	11114	19864	44
17	80151	88875	91276	08724	11124	19849	43
18	80166	88865	91301	08699	11135	19833	42
19	80182	88854	91327	08673	11145	19818	41
20	9.80197	9.88844	9.91353	10.08647	10.11156	10.19803	40
21	80213	88834	91379	08621	11166	19787	39
22	80228	88824	91409	08596	11176	19772	38
23	80243	88813	91430	08570	11187	19756	37
24	80259	88803	91456	08544	11197	19741	36
25	80274	88793	91482	08518	11207	19726	35
26	80290	88782	91507	08492	11218	19710	34
27	80305	88772	91533	08467	11228	19695	33
28	80320	88761	91559	08441	11239	19680	32
29	80336	88751	91585	08415	11249	19664	31
30	9.80351	9.88741	9.91610	10.08389	10.11259	10.19649	30
31	80366	88730	91636	08364	11270	19634	29
32	80382	88720	91662	08338	11280	19618	28
33	80397	88709	91688	08312	11291	19603	27
34	80412	88699	91713	08287	11301	19588	26
35	80428	88688	91739	08261	11311	19572	25
36	80443	88678	91765	08235	11322	19557	24
37	80458	88668	91790	08209	11332	19542	23
38	80473	88657	91816	08184	11343	19527	22
39	80489	88647	91842	08158	11353	19511	21
40	9.80504	9.88636	9.91868	10.08132	10.11364	10.19497	20
41	80519	88626	91893	08107	11374	19481	19
42	80534	88615	91919	08081	11385	19466	18
43	80549	88605	91945	08055	11395	19450	17
44	80565	88594	91970	08029	11406	19435	16
45	80580	88584	91996	08004	11416	19420	15
46	80595	88573	92022	07978	11427	19405	14
47	80610	88563	92048	07952	11437	19390	13
48	80625	88552	92073	07927	11448	19375	12
49	80641	88542	92098	07901	11458	19359	11
50	9.80656	9.88531	9.92125	11.07875	10.11469	10.19344	10
51	80671	88520	92150	07850	11479	19329	9
52	80686	88510	92176	07824	11490	19314	8
53	80701	88499	92202	07798	11501	19299	7
54	80716	88489	92227	07773	11511	19284	6
55	80731	88478	92253	07747	11522	19269	5
56	80746	88468	92279	07721	11532	19253	4
57	80761	88457	92304	07696	11543	19238	3
58	80777	88447	92330	07670	11553	19223	2
59	80792	88436	92356	07644	11564	19208	1
60	80806	88425	92381	07620	11575	19193	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secan.	Secant.	M.

50 Degrees.

A Table of Artificial Sines, Tang. and Sec. 40 Degrees.

M.	Sine.	Co-sine.	Tan.	Co-tang.	Secant.	Co-secant.	
0	9.80807	9.88425	9.92381	10.07019	10.11574	10.19193	60
1	80822	88415	92407	07593	11585	19178	59
2	80837	88404	92433	07567	11596	19163	58
3	80852	88394	92458	07542	11606	19148	57
4	80867	88383	92484	07516	11617	19133	56
5	80882	88372	92510	07490	11628	19118	55
6	80897	88362	92535	07465	11638	19103	54
7	80912	88351	92561	07439	11649	19088	53
8	80927	88340	92586	07413	11660	19073	52
9	80942	88330	92612	07388	11670	19058	51
10	9.80957	9.88319	9.92638	10.07362	10.11681	10.19043	50
11	80972	88308	92663	07337	11692	19028	49
12	80987	88298	92689	07311	11702	19013	48
13	81002	88287	92715	07285	11713	18998	47
14	81017	88276	92740	07260	11724	18983	46
15	81032	88266	92766	07234	11734	18968	45
16	81046	88255	92791	07208	11745	18953	44
17	81061	88244	92817	07183	11756	18939	43
18	81076	88234	92843	07157	11766	18924	42
19	81091	88223	92868	07132	11777	18909	41
20	9.81106	9.88212	9.92894	10.07106	10.11788	10.18894	40
21	81121	88201	92920	07080	11799	18879	39
22	81136	88191	92945	07055	11809	18864	38
23	81151	88180	92971	07029	11820	18849	37
24	81165	88169	92996	07004	11831	18834	36
25	81180	88158	93022	06978	11842	18819	35
26	81195	88148	93047	06952	11852	18805	34
27	81210	88137	93073	06927	11863	18790	33
28	81225	88126	93099	06901	11874	18775	32
29	81240	88115	93124	06876	11885	18760	31
30	9.81254	9.88105	9.93150	10.06850	10.11895	10.18745	30
31	81269	88094	93175	06824	11906	18731	29
32	81284	88083	93201	06799	11917	18716	28
33	81299	88072	93227	06773	11928	18701	27
34	81313	88061	93252	06748	11939	18686	26
35	81328	88050	93278	06722	11949	18671	25
36	81343	88040	93303	06697	11960	18657	24
37	81358	88029	93329	06671	11971	18642	23
38	81372	88018	93354	06645	11982	18627	22
39	81387	88007	93380	06620	11993	18613	21
40	9.81402	9.87996	9.93406	10.06594	10.12004	10.18598	20
41	81417	87985	93431	06569	12014	18583	19
42	81431	87975	93457	06543	12025	18569	18
43	81446	87964	93482	06518	12036	18554	17
44	81461	87953	93508	06492	12047	18539	16
45	81475	87942	93533	06467	12058	18525	15
46	81490	87931	93559	06441	12069	18510	14
47	81505	87920	93584	06416	12080	18495	13
48	81519	87909	93610	06390	12091	18481	12
49	81534	87898	93635	06364	12102	18466	11
50	9.81549	9.87887	9.93661	10.06339	10.12112	10.18451	10
51	81563	87877	93687	06313	12123	18437	9
52	81578	87866	93712	06288	12134	18422	8
53	81592	87855	93738	06262	12145	18408	7
54	81607	87844	93763	06237	12156	18393	6
55	81621	87833	93789	06211	12167	18378	5
56	81636	87822	93814	06186	12178	18364	4
57	81651	87811	93840	06160	12189	18349	3
58	81665	87800	93865	06135	12200	18335	2
59	81680	87789	93891	06109	12211	18320	1
60	81694	87778	93916	06084	12222	18306	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 41 Degrees.

M.	Sine.	Co-sine.	Tang.	Co-tang.	Secant.	Co-secan.	
0	9.81694	9.87778	9.93916	10.06084	10.12222	10.18305	00.
1	81709	87767	93942	06058	12233	18291	59
2	81723	87756	93997	06033	12244	18277	58
3	81738	87745	93993	06007	12255	18262	57
4	81752	87734	94018	05982	12266	18248	56
5	81767	87723	94044	05956	12277	18233	55
6	81781	87712	94069	05931	12288	18219	54
7	81796	87701	94095	05905	12299	18204	53
8	81810	87690	94120	05880	12310	18190	52
9	81825	87679	94146	05854	12321	18175	51
10	9.81839	9.87668	9.94171	10.05829	10.12332	10.18161	50
11	81854	87657	94197	05803	12343	18146	49
12	81868	87646	94222	05778	12354	18132	48
13	81882	87634	94248	05752	12365	18117	47
14	81897	87624	94273	05727	12376	18103	46
15	81911	87612	94299	05701	12387	18089	45
16	81926	87601	94324	05676	12399	18074	44
17	81940	87590	94350	05650	12410	18060	43
18	81954	87579	94375	05625	12421	18045	42
19	81969	87568	94401	05599	12432	18031	41
20	9.81983	9.87557	9.94426	10.05574	10.12443	10.18017	40
21	81998	87546	94452	05548	12454	18002	39
22	82012	87535	94477	05523	12465	17988	38
23	82026	87524	94503	05497	12476	17974	37
24	82041	87513	94528	05472	12487	17959	36
25	82055	87501	94553	05446	12499	17945	35
26	82069	87490	94579	05421	12510	17931	34
27	82084	87479	94604	05395	12521	17916	33
28	82098	87463	94630	05370	12532	17902	32
29	82112	87457	94655	05345	12543	17888	31
30	9.82126	9.87446	9.94681	10.05319	10.12554	10.17873	30
31	82141	87434	94706	05294	12566	17859	29
32	82155	87423	94732	05268	12577	17845	28
33	82169	87412	94757	05243	12588	17831	27
34	82183	87401	94783	05217	12599	17816	26
35	82198	87390	94808	05192	12610	17802	25
36	82212	87378	94833	05166	12622	17788	24
37	82226	87367	94859	05141	12632	17774	23
38	82240	87356	94884	05116	12644	17760	22
39	82255	87345	94910	05090	12655	17745	21
40	9.82269	9.87333	9.94935	10.05065	10.12666	10.17731	20
41	82283	87322	94961	05039	12678	17717	19
42	82297	87311	94986	05014	12689	17703	18
43	82311	87300	95012	04988	12700	17689	17
44	82325	87288	95037	04963	12711	17674	16
45	82340	87277	95062	04937	12723	17660	15
46	82353	87266	95088	04912	12734	17646	14
47	82368	87255	95113	04887	12745	17632	13
48	82382	87243	95139	04861	12757	17618	12
49	82396	87232	95164	04836	12768	17604	11
50	9.82410	9.87221	9.95190	10.04810	10.12779	10.17590	10
51	82424	87209	95215	04785	12791	17575	9
52	82439	87198	95240	04759	12802	17561	8
53	82453	87187	95266	04734	12813	17547	7
54	82467	87175	95291	04709	12824	17533	6
55	82481	87164	95317	04683	12836	17519	5
56	82495	87153	95342	04658	12847	17505	4
57	82509	87141	95367	04632	12859	17491	3
58	82523	87130	95393	04607	12870	17477	2
59	82537	87119	95418	04582	12881	17463	1
60	82551	87107	95444	04556	12893	17446	0
	Co fine.	Sine.	Co-tang.	Tang.	Co-secan.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 42 Degrees.

M.	Sine.	Co-sine.	Tang.	Co-tang.	Secant.	Co-secan.	M.
0	9.82551	9.87107	9.95444	10.04556	10.12893	10.17449	60
1	82565	87096	95469	04531	12904	17435	59
2	82579	87085	95494	04505	12915	17421	58
3	82593	87073	95520	04480	12927	17407	57
4	82607	87062	95545	04455	12938	17393	56
5	82621	87050	95571	04429	12950	17379	55
6	82635	87039	95596	04404	12961	17365	54
7	82649	87028	95621	04378	12972	17351	53
8	82663	87016	95647	04353	12984	17337	52
9	82677	87005	95672	04328	12995	17323	51
10	9.82691	9.86993	9.95698	10.04302	10.13007	10.17309	50
11	82705	86982	95723	04277	13018	17295	49
12	82719	86970	95748	04251	13030	17281	48
13	82733	86959	95774	04226	13041	17267	47
14	82747	86947	95799	04201	13053	17253	46
15	82761	86936	95825	04175	13064	17239	45
16	82774	86924	95850	04150	13075	17226	44
17	82788	86913	95875	04125	13087	17212	43
18	82802	86901	95901	04099	13098	17198	42
19	82816	86890	95926	04074	13110	17184	41
20	9.82830	9.86878	9.95951	10.04048	10.13121	10.17170	40
21	82844	86867	95977	04023	13133	17156	39
22	82858	86855	96002	03998	13144	17142	38
23	82872	86844	96028	03972	13156	17128	37
24	82885	86832	96053	03947	13168	17114	36
25	82899	86821	96078	03922	13179	17100	35
26	82913	86809	96104	03896	13190	17087	34
27	82927	86798	96129	03871	13202	17073	33
28	82941	86786	96154	03845	13214	17059	32
29	82954	86775	96180	03820	13225	17045	31
30	9.82968	9.86763	9.96205	10.03795	10.13237	10.17032	30
31	82982	86751	96231	03769	13248	17018	29
32	82996	86740	96256	03744	13260	17004	28
33	83010	86728	96281	03719	13272	16990	27
34	83023	86717	96307	03693	13283	16962	26
35	83037	86705	96332	03668	13295	16949	25
36	83051	86693	96357	03643	13306	16935	24
37	83065	86682	96383	03617	13318	16922	23
38	83078	86670	96408	03592	13330	16908	22
39	83092	86659	96433	03566	13341	16908	21
40	9.83106	9.86647	9.96459	10.03541	10.13353	10.16894	20
41	83119	86635	96484	03516	13365	16880	19
42	83133	86624	96509	03490	13376	16867	18
43	83147	86612	96535	03465	13388	16853	17
44	83161	86600	96560	03440	13400	16839	16
45	83174	86589	96585	03414	13411	16826	15
46	83188	86576	96611	03389	13423	16812	14
47	83202	86565	96636	03364	13435	16798	13
48	83215	86553	96662	03338	13446	16785	12
49	83229	86542	96687	03313	13458	16771	11
50	9.83242	9.86536	9.96712	10.03288	10.13470	10.16757	10
51	83256	86518	96738	03262	13481	16744	9
52	83270	86507	96763	03237	13493	16730	8
53	83283	86495	96788	03212	13505	16717	7
54	83297	86483	96814	03186	13517	16703	6
55	83310	86472	96839	03161	13528	16689	5
56	83324	86460	96864	03136	13540	16676	4
57	83338	86448	96890	03110	13552	16662	3
58	83351	86436	96915	03085	13564	16649	2
59	83365	86424	96940	03060	13575	16635	1
60	83378	86413	96966	03034	13587	16622	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secan.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 43 Degrees.

M.	Sine.	Co-sine.	Tang.	Co tang.	Secant.	Co-secan.	M.
0	9.83378	9.86413	9.96966	10.03034	10.13507	10.16522	00
1	83392	86401	96991	03009	13599	16608	59
2	83405	86389	97016	02984	13611	16595	58
3	83419	86377	97041	02958	13623	16581	57
4	83432	86366	97067	02933	13634	16567	56
5	83446	86354	97092	02908	13646	16554	55
6	83459	86342	97118	02882	13658	16540	54
7	83473	86330	97143	02857	13670	16527	53
8	83486	86318	97168	02832	13682	16513	52
9	83500	86306	97193	02806	13694	16500	51
10	9.83513	9.86295	9.97219	10.02781	10.13705	10.16487	50
11	83527	86283	97244	02756	13717	16473	49
12	83540	86271	97269	02731	13729	16460	48
13	83554	86259	97295	02705	13741	16446	47
14	83567	86247	97320	02680	13753	16433	46
15	83581	86235	97345	02655	13765	16419	45
16	83594	86223	97371	02629	13777	16406	44
17	83607	86211	97396	02604	13788	16392	43
18	83621	86200	97421	02579	13800	16379	42
19	83634	86188	97447	02553	13812	16366	41
20	9.83648	9.86176	9.97472	10.02528	10.13824	10.16352	40
21	83661	86164	97497	02503	13836	16339	39
22	83674	86152	97523	02477	13848	16325	38
23	83688	86140	97548	02452	13860	16312	37
24	83701	86128	97573	02427	13872	16299	36
25	83715	86116	97598	02401	13884	16285	35
26	83728	86104	97624	02376	13896	16272	34
27	83741	86092	97649	02351	13908	16259	33
28	83755	86080	97674	02326	13920	16245	32
29	83768	86068	97700	02300	13932	16232	31
30	9.83781	9.86056	9.97725	10.02275	10.13942	10.16219	30
31	83794	86044	97750	02250	13956	16206	29
32	83808	86032	97776	02224	13968	16192	28
33	83821	86020	97801	02199	13980	16179	27
34	83834	86008	97826	02174	13992	16166	26
35	83848	85996	97851	02149	14004	16152	25
36	83861	85984	97877	02123	14016	16139	24
37	83874	85972	97902	02098	14028	16126	23
38	83887	85960	97927	02073	14040	16112	22
39	83901	85948	97953	02047	14052	16099	21
40	9.83914	9.85936	9.97978	10.02022	10.14064	10.16016	20
41	83927	85924	98003	01997	14076	16073	19
42	83940	85912	98029	01971	14088	16060	18
43	83954	85900	98054	01946	14100	16046	17
44	83967	85888	98079	01921	14112	16033	16
45	83980	85876	98104	01896	14124	16020	15
46	83993	85864	98130	01870	14136	16007	14
47	84006	85851	98155	01845	14149	15994	13
48	84020	85839	98180	01820	14161	15980	12
49	84033	85827	98206	01794	14173	15967	11
50	9.84046	9.85815	9.98231	10.01769	10.14185	10.15954	10
51	84059	85803	98256	01743	14197	15941	9
52	84072	85791	98281	01719	14209	15928	8
53	84085	85779	98307	01693	14221	15915	7
54	84098	85766	98332	01668	14234	15901	6
55	84112	85754	98357	01643	14246	15888	5
56	84125	85742	98383	01617	14258	15875	4
57	84138	85730	98408	01592	14270	15862	3
58	84151	85718	98433	01567	14282	15849	2
59	84164	85706	98458	01542	14294	15836	1
60	84177	85693	98484	01516	14307	15823	0
Co-sine.	Sine.	Co-tang.	Tangent.	Co-secan.	Secant.	M.	

A Table of Artificial Sines, Tang. and Sec. 44 Degrees.

M.	Sine.	Co-sine.	Tang.	Co-tang.	Secant.	Co-secant.	M.
0	9.84177	9.85693	9.98484	10.01516	10.14307	10.15823	60
1	84190	85681	98509	01491	14319	15810	59
2	84203	85669	98534	01466	14331	15797	58
3	84216	85657	98560	01440	14343	15784	57
4	84229	85645	98585	01415	14355	15771	56
5	84242	85632	98610	01390	14368	15758	55
6	84255	85620	98635	01365	14380	15745	54
7	84268	85608	98661	01339	14392	15731	53
8	84282	85596	98686	01314	14404	15718	52
9	84295	85583	98711	01289	14417	15705	51
10	9.84308	9.85571	9.98736	10.01263	10.14429	10.15692	50
11	84320	85559	98762	01238	14441	15679	49
12	84334	85546	98787	01213	14453	15666	48
13	84346	85534	98812	01188	14466	15653	47
14	84359	85522	98838	01162	14478	15640	46
15	84372	85510	98863	01137	14490	15628	45
16	84385	85497	98888	01112	14502	15614	44
17	84398	85485	98913	01087	14515	15602	43
18	84411	85473	98939	01061	14527	15589	42
19	84424	85460	98964	01036	14540	15576	41
20	9.84437	9.85448	9.98984	10.01011	10.14552	10.15563	40
21	84450	85436	99014	00985	14564	15550	39
22	84463	85423	99040	00960	14577	15537	38
23	84476	85411	99065	00935	14589	15524	37
24	84489	85399	99090	00909	14601	15511	36
25	84502	85386	99116	00884	14614	15498	35
26	84515	85374	99141	00859	14626	15485	34
27	84528	85361	99166	00834	14639	15472	33
28	84540	85349	99191	00809	14651	15460	32
29	84553	85337	99217	00783	14663	15446	31
30	9.84566	9.85324	9.99242	10.00758	10.14676	10.15434	30
31	84579	85312	99267	00733	14688	15421	29
32	84592	85299	99292	00707	14701	15408	28
33	84605	85287	99318	00682	14713	15395	27
34	84618	85274	99343	00657	14725	15382	26
35	84630	85262	99368	00632	14738	15370	25
36	84643	85250	99394	00606	14750	15357	24
37	84656	85237	99419	00581	14763	15344	23
38	84669	85225	99444	00556	14775	15331	22
39	84682	85212	99469	00531	14788	15318	21
40	9.84694	9.85200	9.99495	10.00505	10.14800	10.15306	20
41	84707	85187	99520	00480	14813	15293	19
42	84720	85175	99545	00455	14825	15280	18
43	84733	85162	99570	00430	14838	15267	17
44	84745	85150	99596	00404	14850	15255	16
45	84758	85137	99621	00379	14863	15242	15
46	84771	85125	99646	00354	14875	15229	14
47	84784	85112	99672	00328	14888	15216	13
48	84796	85100	99697	00303	14900	15204	12
49	84809	85087	99722	00278	14913	15191	11
50	9.84822	9.85074	9.99747	10.00253	10.14925	10.15178	10
51	84834	85062	99773	00227	14938	15166	9
52	84847	85049	99798	00202	14951	15153	8
53	84860	85037	99823	00177	14963	15140	7
54	84873	85024	99848	00152	14976	15127	6
55	84885	85012	99874	00126	14988	15115	5
56	84898	84999	99899	00101	15001	15102	4
57	84911	84986	99924	00076	15014	15089	3
58	84923	84974	99949	00050	15026	15077	2
59	84936	84961	99975	00025	15039	15064	1
60	84948	84948	10.00000	00000	15052	85051	0
	Co-sine.	Sine.	Co tang.	Tangent.	Co-secant.	Secant.	M.

A TABLE of the SUN'S DECLINATION for the
YEARS 1773, 1777, 1781, 1785, 1789, 1793, 1797.

First after LEAP-YEAR.

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
days	South	South	South	North	North	North	North	North	North	South	South	South
	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.
1	22 58	16 55	07 20	04 46	15 15	22 09	23 06	17 55	08 07	03 24	14 38	21 56
2	22 52	16 37	06 58	05 10	15 33	22 16	23 02	17 40	07 45	03 47	14 57	22 05
3	22 47	16 20	06 35	05 32	15 51	22 24	22 57	17 24	07 23	04 11	15 16	22 13
4	22 40	16 2	06 11	05 55	16 08	22 31	22 52	17 08	07 00	04 34	15 35	22 21
5	22 33	15 43	05 48	06 18	16 25	22 37	22 46	16 52	06 38	04 57	15 53	22 29
6	22 26	15 25	05 25	06 41	16 42	22 43	22 40	16 35	06 16	05 20	16 11	22 36
7	22 18	15 06	05 02	07 03	16 58	22 49	22 34	16 19	05 53	05 43	16 29	22 42
8	22 10	14 47	04 38	07 26	17 15	22 55	22 27	16 02	05 30	06 06	16 46	22 49
9	22 01	14 28	04 15	07 48	17 31	23 0	22 20	15 44	05 08	06 29	17 03	22 54
10	21 52	14 8	03 51	08 10	17 46	23 4	22 12	15 27	04 45	06 52	17 20	23 00
11	21 43	13 48	03 28	08 32	18 02	23 08	22 04	15 9	04 22	07 15	17 37	23 05
12	21 33	13 28	03 4	08 54	18 17	23 12	21 56	14 51	03 59	07 37	17 53	23 09
13	21 23	13 8	02 41	09 16	18 32	23 16	21 47	14 32	03 36	08 0	18 09	23 13
14	21 12	12 48	02 17	09 37	18 46	23 19	21 38	14 14	03 13	08 22	18 25	23 17
15	21 01	12 27	01 53	09 59	19 0	23 21	21 29	13 55	02 50	08 44	18 40	23 20
16	20 49	12 6	01 30	10 20	19 14	23 23	21 19	13 36	02 27	09 06	18 55	23 22
17	20 37	11 45	01 6	10 41	19 28	23 25	21 09	13 17	02 03	09 28	19 10	23 24
18	20 25	11 24	00 42	11 02	19 41	23 26	20 58	12 57	01 40	09 50	19 24	23 26
19	20 12	11 03	00 19	11 22	19 54	23 27	20 47	12 38	01 17	10 12	19 38	23 27
20	19 59	10 41	No. 5	11 43	20 06	23 28	20 36	12 18	00 53	10 34	19 51	23 28
21	19 46	10 19	00 29	12 03	20 18	23 28	20 24	11 58	00 30	10 55	20 5	23 28
22	19 32	09 58	00 52	12 24	20 30	23 28	20 12	11 38	00 06	11 16	20 18	23 28
23	19 18	09 35	01 16	12 43	20 42	23 27	20 0	11 17	S. 17	11 37	20 30	23 27
24	19 03	09 13	01 40	13 03	20 53	23 26	19 48	10 57	00 40	11 58	20 42	23 26
25	18 48	08 51	02 3	13 23	21 04	23 24	19 35	10 36	01 04	12 19	20 54	23 24
26	18 33	08 28	02 27	13 42	21 14	23 22	19 21	10 15	01 27	12 40	21 05	23 22
27	18 18	08 6	02 50	14 01	21 24	23 20	19 08	09 54	01 51	13 0	21 16	23 19
28	18 02	07 43	03 14	14 20	21 34	23 17	18 54	09 33	02 14	13 20	21 27	23 16
29	17 45		03 37	14 39	21 43	23 14	18 40	09 12	02 38	13 40	21 37	23 13
30	17 29		04 0	14 57	21 52	23 10	18 25	08 50	03 1	14 0	21 46	23 09
31	17 12		04 23		22 0		18 10	08 28		14 19		23 04

A TABLE of the SUN'S DECLINATION of the YEARS 1774, 1778, 1782, 1786, 1790, 1794, 1798.

Each being the Second after LEAP-YEAR.

	Jan.	Eeb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Days	South	South	South	North	North	North	North	North	North	South	South	South
	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.
1	22 59	16 59	07 26	01 41	15 11	22 07	23 07	17 59	08 12	03 19	14 34	21 53
2	22 54	16 42	07 03	05 04	15 29	22 14	23 03	17 44	07 50	03 42	14 53	22 02
3	22 48	16 24	06 40	05 27	15 46	22 22	22 58	17 28	07 28	04 05	15 12	22 11
4	22 42	16 06	06 17	05 50	16 04	22 29	22 53	17 12	07 06	04 28	15 30	22 19
5	22 35	15 48	05 54	06 12	16 21	22 36	22 48	16 56	06 43	04 52	15 49	22 27
6	22 28	15 30	05 31	06 35	16 38	22 42	22 42	16 39	06 21	05 15	16 07	22 34
7	22 20	15 11	05 08	06 58	16 54	22 48	22 35	16 23	05 58	05 38	16 24	22 41
8	22 12	14 52	04 44	07 20	17 11	22 53	22 29	16 06	05 36	06 16	16 42	22 47
9	22 04	14 33	04 21	07 42	17 27	22 59	22 21	15 48	05 13	06 24	16 59	22 53
10	21 55	14 13	03 57	08 05	17 42	23 03	22 14	15 31	04 50	06 46	17 16	22 59
11	21 45	13 53	03 34	08 27	17 58	23 08	22 06	15 13	04 27	07 09	17 33	23 04
12	21 35	13 33	03 10	08 48	18 13	23 11	21 58	14 55	04 05	07 32	17 49	23 08
13	21 25	13 13	02 46	09 10	18 28	23 15	21 49	14 37	03 42	07 54	18 05	23 12
14	21 15	12 53	02 23	09 32	18 43	23 18	21 40	14 18	03 18	08 17	18 21	23 16
15	21 04	12 32	01 59	09 53	18 57	23 21	21 31	14 00	02 55	08 39	18 36	23 19
16	20 52	12 11	01 35	10 15	19 11	23 23	21 21	13 41	02 32	09 01	18 51	23 22
17	20 40	11 50	01 12	10 36	19 24	23 25	21 11	13 21	02 09	09 23	19 06	23 24
18	20 28	11 29	00 48	10 57	19 38	23 26	21 01	13 02	01 46	09 45	19 20	23 26
19	20 15	11 08	00 24	11 17	19 50	23 27	20 50	12 43	01 22	10 07	19 34	23 27
20	20 02	10 46	00 01	11 38	20 03	23 28	20 39	12 23	00 59	10 28	19 48	23 28
21	19 49	10 25	N. 23	11 58	20 15	23 28	20 27	12 03	00 36	10 50	20 01	23 28
22	19 35	10 03	00 47	12 19	20 27	23 28	20 15	11 43	00 12	11 11	20 14	23 28
23	19 21	09 41	01 10	12 39	20 39	23 27	20 03	11 22	So. 11	11 32	20 27	23 27
24	19 07	09 19	01 34	12 58	20 50	23 26	19 51	11 02	00 35	11 53	20 39	23 26
25	18 52	08 56	01 57	13 18	21 01	23 25	19 38	10 41	00 58	12 14	20 51	23 25
26	18 37	08 34	02 21	13 37	21 11	23 23	19 25	10 20	01 22	12 35	21 02	23 23
27	18 21	08 12	02 44	13 56	21 21	23 20	19 11	09 59	01 45	12 55	21 13	23 20
28	18 06	07 49	03 08	14 15	21 31	23 18	18 57	09 38	02 08	13 15	21 24	23 17
29	17 49		03 31	14 34	21 41	23 15	18 43	09 17	02 32	13 35	21 34	23 14
30	17 33		03 54	14 52	21 50	23 11	18 28	08 55	02 55	13 55	21 44	23 10
31	17 16		04 18		21 58		18 14	08 34		14 14		23 5

A TABLE of the SUN'S DECLINATION for the YEARS 1775, 1779, 1783, 1787, 1791, 1795, 1799.

Third after LEAP-YEAR.

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
days	South	South	South	North	North	North	North	North	North	South	South	South
	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.
1	23 01	17 04	7 32	4 35	15 6	22 05	23 8	18 3	8 17	3 13	14 29	21 51
2	22 55	16 46	7 9	4 58	15 24	22 13	23 4	17 47	7 55	3 36	14 48	22 0
3	22 50	16 29	6 46	5 21	15 42	22 20	22 59	17 32	7 33	4 0	15 7	22 9
4	22 43	16 11	6 23	5 44	16 0	22 27	22 54	17 16	7 11	4 23	15 26	22 17
5	22 37	15 53	6 0	6 7	16 17	22 34	22 49	17 0	6 49	4 46	15 44	22 25
6	22 30	15 34	5 37	6 29	16 34	22 41	22 43	16 43	6 26	5 9	16 2	22 32
7	22 22	15 16	5 13	6 52	16 51	22 47	22 37	16 27	6 4	5 32	16 20	22 39
8	22 14	14 57	4 50	7 14	17 07	22 52	22 30	16 10	5 41	5 55	16 38	22 46
9	22 06	14 37	4 26	7 37	17 23	22 57	22 23	15 53	5 19	6 18	16 55	22 52
10	21 57	14 18	4 3	7 59	17 39	23 2	22 16	15 35	4 56	6 41	17 12	23 57
11	21 48	13 58	3 39	8 21	17 54	23 7	22 8	15 17	4 33	7 4	17 29	23 2
12	21 38	13 38	3 16	8 43	18 10	23 11	22 0	14 59	4 10	7 26	17 45	23 7
13	21 28	13 18	3 52	9 05	18 25	23 14	21 52	14 41	3 47	7 49	18 1	23 11
14	21 17	12 58	2 29	9 26	18 39	23 17	21 43	14 23	3 24	8 11	18 17	23 15
15	21 06	12 37	2 5	9 48	18 53	23 20	21 33	14 4	3 1	8 34	18 33	23 18
16	20 55	12 17	1 41	10 9	19 7	23 23	21 24	13 45	2 38	8 56	18 48	23 21
17	20 43	11 56	1 18	10 31	19 21	23 25	21 14	13 26	2 15	9 18	19 3	23 23
18	20 31	11 35	0 54	10 52	19 34	23 26	21 3	13 7	1 51	9 40	19 17	23 25
19	20 19	11 13	0 30	11 12	19 47	23 27	20 53	12 47	1 28	10 2	19 31	23 27
20	20 06	10 52	0 7	11 33	20 0	23 28	20 42	12 28	1 5	10 23	19 45	23 28
21	19 53	10 30	N. 17	11 54	20 12	23 28	20 30	12 8	0 41	10 45	19 58	23 28
22	19 39	10 8	0 41	12 14	20 24	23 28	20 18	11 48	0 18	11 6	20 11	23 28
23	19 25	9 46	1 04	12 34	20 36	23 27	20 6	11 27	So. 6	11 27	20 24	23 27
24	19 11	9 24	1 28	12 54	20 47	23 27	19 54	11 7	0 29	11 48	20 36	23 26
25	18 56	9 02	1 52	13 13	20 58	23 25	19 41	10 46	0 52	12 9	20 48	23 25
26	18 41	8 40	2 15	13 33	21 9	23 23	19 28	10 25	1 16	12 30	21 0	23 23
27	18 25	8 17	2 39	13 52	21 19	23 21	19 15	10 4	1 39	12 50	21 11	23 21
28	18 10	7 54	3 2	14 11	21 29	23 19	19 1	9 43	3 3	13 10	21 22	23 18
29	17 54		3 25	14 30	21 38	23 16	18 47	9 22	3 26	13 30	21 32	23 15
30	17 37		3 49	14 48	21 48	23 12	18 32	9 0	3 49	13 50	21 42	23 11
31	17 21		4 12		21 56		18 18	8 39		14 10		23 7

A TABLE of the SUN'S DECLINATION for the Years 1776, 1780, 1784, 1788, 1792, 1796, 1800.

Each being LEAP-YEAR.

	Jan.	Feb.	Mar.	April	May	June.	July	Aug.	Sept.	Oct.	Nov.	Dec.
Days	South	South	South	North	North	North	North	North	North	South	South	South
	D.M.	D.M.	D.M.	D. M	D. M	D. M	D.M.	D. M	D. M	D. M	D. M	D. M
1	23 2	17 8	7 14	4 53	15 20	22 11	23 5	17 51	8 1	3 31	14 44	21 58
2	22 57	16 50	6 51	5 16	15 38	22 18	23 11	17 36	7 39	3 54	15 3	22 7
3	22 51	16 33	6 28	5 39	15 55	22 26	22 56	17 20	7 16	4 17	15 21	22 15
4	22 45	16 15	6 1	6 1	16 13	22 33	22 50	17 4	6 54	4 40	15 40	22 23
5	22 39	15 57	5 42	6 24	16 30	22 39	22 45	16 47	6 32	5 3	15 58	22 31
6	22 32	15 39	5 19	6 47	16 46	22 45	22 38	16 31	6 9	5 26	16 16	22 38
7	22 24	15 20	4 55	7 9	17 3	22 51	22 32	16 14	5 47	5 49	16 33	22 44
8	22 16	15 1	4 32	7 31	17 19	22 56	22 25	15 57	5 24	6 12	16 51	22 50
9	22 8	14 42	4 9	7 54	17 35	23 1	22 18	15 39	5 2	6 35	17 8	23 56
10	21 59	14 23	3 45	8 16	17 51	23 6	22 10	15 22	4 39	6 58	17 25	23 1
11	21 50	14 3	3 22	8 32	18 6	23 10	22 2	15 4	4 16	7 21	17 41	23 6
12	21 40	13 43	2 58	9 0	18 21	23 13	21 54	14 46	3 53	7 43	17 57	23 10
13	21 30	13 23	2 34	9 21	18 36	23 17	21 45	14 27	3 30	8 6	18 13	23 14
14	21 20	13 3	2 11	9 43	18 50	23 20	21 36	14 9	3 7	8 28	18 29	23 18
15	21 9	12 42	1 47	10 4	19 4	23 22	21 26	13 50	2 44	8 50	18 44	23 20
16	20 58	12 22	1 23	10 25	19 18	23 24	21 16	13 31	2 20	9 12	18 59	23 23
17	20 46	12 1	1 0	10 46	19 31	23 26	21 6	13 12	1 57	9 34	19 14	23 25
18	20 34	11 40	0 36	11 7	19 44	23 27	20 55	12 52	1 34	9 56	19 28	23 26
19	20 22	11 18	0 12	11 28	19 57	23 28	20 43	12 33	1 10	10 18	19 42	23 27
20	20 9	10 57	N. 11	11 49	20 3	23 28	20 33	12 13	0 47	10 59	19 55	23 28
21	19 50	10 35	0 35	12 9	20 22	23 28	20 21	11 53	0 24	11 1	20 8	23 28
22	19 42	10 14	0 59	12 29	20 33	23 28	20 9	11 32	0 0	11 22	20 21	23 28
23	19 28	9 52	1 22	12 49	20 45	23 27	19 57	11 12	S. 23	11 43	20 32	23 27
24	19 14	9 30	1 46	13 9	20 56	23 26	19 44	10 51	0 47	12 4	20 45	23 26
25	18 59	9 7	2 9	13 28	21 6	23 24	19 31	10 30	1 10	12 25	20 57	23 24
26	18 44	8 45	2 33	13 47	21 17	23 22	19 18	10 9	1 34	12 45	21 8	23 21
27	18 29	8 23	2 56	14 6	21 27	23 19	19 4	9 48	1 57	13 5	21 19	23 19
28	18 13	8 0	3 20	14 25	21 36	23 16	18 50	9 27	2 21	13 25	21 30	23 16
29	17 57	7 37	3 43	14 44	21 45	23 13	18 36	9 6	2 44	13 45	21 39	23 12
30	17 41		4 6	15 2	21 54	23 9	18 21	8 44	3 7	14 5	21 49	23 8
31	17 23		4 29		22 3		18 6	8 22		14 24		23 3

A TABLE of the VARIATION of the SUN'S DECLINATION to every 10 DEGREES of LONGITUDE.

DEGREES of LONGITUDE from the MERIDIAN of LONDON.																		
Daily Var.	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
Min.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1
3	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1
4	0	0	0	0	1	1	1	1	1	1	1	1	1	2	2	2	2	2
5	0	0	0	0	1	1	1	1	1	1	1	2	2	2	2	2	2	2
6	0	0	0	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3
7	0	0	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	3
8	0	0	1	1	1	1	1	2	2	2	2	3	3	3	3	3	4	4
9	0	0	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4
10	0	1	1	1	1	2	2	2	3	3	3	3	4	4	4	5	5	5
11	0	1	1	1	2	2	2	3	3	3	3	4	4	4	5	5	5	5
12	0	1	1	1	2	2	2	3	3	3	4	4	4	5	5	5	6	6
13	0	1	1	1	2	2	2	3	3	3	4	4	4	5	5	5	6	6
14	0	1	1	2	2	2	3	3	3	4	4	4	5	5	5	6	6	7
15	0	1	1	2	2	3	3	3	4	4	5	5	5	6	6	6	7	7
16	0	1	1	2	2	3	3	4	4	5	5	5	6	6	7	7	7	8
17	0	1	1	2	2	3	3	4	4	5	5	5	6	6	7	7	8	8
18	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9
19	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9
20	1	1	2	2	3	3	4	4	5	6	6	7	7	8	8	9	9	10
21	1	1	2	2	3	4	4	5	5	6	6	7	8	8	9	9	10	10
22	1	1	2	2	3	4	4	5	6	6	7	7	8	9	9	10	10	11
23	1	1	2	3	3	4	4	5	6	6	7	8	8	9	10	10	11	11
24	1	1	2	3	3	4	5	5	6	7	7	8	9	9	10	11	11	12

To find the SUN'S DECLINATION by the foregoing TABLES.

EACH Page of the foregoing Tables contains the Sun's Declination for the Years that it is mark'd with at the Top, and is divided into thirteen Columns; the First of which to the Left-Hand shews the Day of the Month, and the other Twelve the Months of the Year, so that if it be required to find the Sun's Declination for any Day; suppose for Example, on the 21st of August, 1775: First I look for that Table that has 1775 at the Top of it, and then right against the 21st Day of the Month, and under August, I find 12, 8, which shews the Sun's Declination to be 12 Degrees 8 Minutes North; according to the Title at the Top of the Column.

The Sun's Declination in these Tables being calculated for the Meridian of London, if you should be considerably to the Eastward, or to the Westward of London, it will cause some Alteration in it; to correct which, the

Table of Variation of the Sun's Declination is to be used as follows:

First, Look out the Declination for the given Day of the Month, and for the Day following it, and subtract the lesser from the greater, the Remainder is the Daily Variation.

Second, Observe whether the Declination be increasing or decreasing, which you may know thus: if the Declination for the Day following the given Day be biggest, then it is increasing; but if it be least, it is decreasing.

Third, Look for the Daily Variation in the first Column of the Table, and see what Number stands right against it, and under the given Degrees of Longitude; which Number is to be used as follows.

If the Difference of Longitude be Easterly, and the Declination increasing, it must be subtracted from the Declination found in the Tables for the given Day; but if the Declination be decreasing, it must be added.

If the Difference of Longitude be Westerly, and the Declination increasing, it must be added; but if the Declination be decreasing, it must be subtracted; the Sum in one Case, and the Remainder in the other, will be the Sun's Declination at Noon in the Longitude required.

Suppose on September 10, 1775, a Ship in Longitude 64 Degrees West of London, what is the Sun's true Declination when on the Ship's Meridian?

	D. M.	} And because the Declination is decreasing, the Difference must be subtracted; therefore opposite to 23, and under 60 Degrees of Longitude stands 4 Minutes, which subtracted from 4° 45' gives 4° 41', the Declination at the Ship.
Decl. at London Sept. 10, 1775,	4 45 N.	
Ditto at London Sept. 11,	4 22 N.	
Daily Variation of Declination.	23 Miles	

Again, suppose in Longitude 73 Degrees East, on March 20, 1775, what is the Sun's Declination?

	D. M.	} Since the Declination is increasing, and the Longitude East, it must be subtracted, and the Remainder being nothing, shews that the Sun is upon the Equinoctial at the Ship's Meridian.
Sun's Decl. March 20,	0 5 N.	
Variation for 73 Degrees	5	
	0 0	
Declination at Noon at Ship.		

In like Manner may the Declination be fitted to any Meridian; but it sometimes happens that the Declination is wanted when the Sun is not upon the Meridian: in such Cases it is best to find the Declination for the preceding and following Noons, and take the Difference, and then say as 24 Hours is to that Difference, so is the Hours from Noon to a Fourth Number, which being added or subtracted, according as the Declination is increasing or decreasing, and the Time being in the Fore or Afternoon, gives the Sun's Declination for the given Time.

Suppose it were required to find the Sun's Declination on April 15, 1775; at 8 Hours 55 Minutes in the Morning.

First, I look in the Tables for the Sun's Declination, April 15, 1775, and find it to be 9° 48'; and then I look for it April 14, and find it to be 9° 26'; the Daily Difference is 22 Minutes: Then I say, as 24 Hours is to 22 Minutes, so is 20H. 55M. the Time elapsed since last Noon; to 19 Minutes, which added to 9° 26', because the Declination is increasing, gives 9° 46' for the Declination at the given Time: but had the Declination been decreasing, the 19 Minutes must have been subtracted.

In like Manner the Declination is found for any Hour of the Day, and under any Meridian; for you have nothing more to do, than to reduce the Difference of Longitude into Time, and add to, or subtract it from the given Time, according as the Longitude is East or West, and then find the Declination as above.



